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United States  
Department of  
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Research and  
Education Committee

May 1984

# 1983 Annual Report on the Food and Agricultural Sciences

From the Secretary of Agriculture  
to the President and the Congress  
of the United States

1983  
JUN 9 1984

U.S. DEPT. OF AGRICULTURE  
RESEARCH AND EDUCATION COMMITTEE  
1983



## PREFACE

This report was prepared under the auspices of the USDA Research and Education Committee, which was established in 1981 as a unit of the Secretary of Agriculture's Policy and Coordination Council. The Assistant Secretary of Agriculture for Science and Education serves as chairperson of the Committee.

USDA agencies providing assistance in the preparation of this report were: Agricultural Cooperative Service (ACS), Agricultural Marketing Service (AMS), Agricultural Research Service (ARS), Cooperative State Research Service (CSRS), Economic Research Service (ERS), Extension Service (ES), Forest Service (FS), Human Nutrition Information Service (HNIS), National Agricultural Library (NAL), Office of International Cooperation and Development (OICD), Office of Transportation (OT), and Statistical Reporting Service (SRS).

Copies of this report can be obtained from:

Executive Secretary  
Research and Education Committee  
USDA, Room 115, Building 005, BARC-W  
Beltsville, Maryland 20705

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## Contents

	<u>Page</u>
Executive Summary . . . . .	i
Federal, State, and Private Industry Support for the Food and Agricultural Sciences	
- Department of Agriculture . . . . .	1
- Other Federally Supported R&E in Food and Agriculture . . . . .	6
- State Support . . . . .	7
- Private Industry R&D. . . . .	8
- Basic Research Outlays. . . . .	8
Significant Activities and Accomplishments in the Food and Agricultural Sciences	
- Agricultural Research Service. . . . .	11
- Cooperative State Research Service . . . . .	13
- Human Nutrition Information Service. . . . .	20
- Economic Research Service. . . . .	22
- Statistical Reporting Service. . . . .	25
- Agricultural Cooperative Service . . . . .	27
- Agricultural Marketing Service . . . . .	28
- Office of Transportation . . . . .	30
- Office of International Cooperation and Development. . . . .	31
- Forest Service . . . . .	34
- Cooperative Extension Service. . . . .	39
- National Agricultural Library. . . . .	43
Food and Agricultural Science Priorities and Directions for the Future	
- Departmental Objectives. . . . .	45
- Advisory Board Recommendations . . . . .	45
- Research Administrators' Projected Change in Research Emphasis, 1983-88. . . . .	48
- Projected Cooperative Extension Program Emphasis, 1983 and Beyond. . . . .	52
Appendix. . . . .	54

## EXECUTIVE SUMMARY

The food and agricultural sciences provide the research and education programs which serve the Nation's largest industry. Agriculture and forestry combined are responsible for approximately 25 percent of gross national product and employment in the United States. These sectors also provided \$18.4 billion in export trade surpluses in Fiscal Year (FY) 1983.

Federal funding, through the U. S. Department of Agriculture, for research and education programs in support of agriculture and forestry have increased significantly over the last decade in current dollars - from \$595 million in FY 1974 to \$1,242 million (estimated) for FY 1984. In constant 1972 dollars, however, total funding actually declined, from \$518 million to \$507 million. USDA funding for research rose over the period in constant dollars, from \$336 million to \$366 million (estimated) in FY 1984. Funding for education decreased, from \$182 million to \$141 million.

Other Federal agencies, industry, and State sources provide significant funding for research and education programs related to agriculture and forestry. In FY 1983, they spent an estimated \$3.7 billion, about three times the level of USDA funding that year.

Public and private research organizations have fundamentally different research roles within the broad spectrum of basic, applied, and developmental research. For example, basic research accounted for about 40 percent of all food and agricultural research funded by USDA and the States in FY 1983. The Agricultural Research Service (ARS) devoted 49 percent of its funds to mission-oriented basic research in FY 1983. Only 10 percent of industry research in the food and agricultural sciences is devoted to basic research.

By definition, research and education are long range, and year-to-year funding cannot be related directly to the results obtained in any one year. Yet in each year, long-term projects produce results. Selected examples of major accomplishments by the 12 USDA research and education agencies in FY 1983 are as follows:

- o Agricultural Research Service scientists have developed a highly sensitive, precise analytical technique to measure vitamin D in milk, blood, and tissues of animals and humans. Concentrations of vitamin D in blood and tissues had to be estimated by inoculating live animals. Use of this laboratory technique opens new avenues to understanding the role of vitamin D in metabolic diseases of the kidney, bone, and intestine of animals and humans.
- o State Agriculture Experiment Stations (SAES) are conducting studies to reduce the cost of commercial nitrogen fertilizer. For example, Kentucky SAES, has shown that placement of nitrogen fertilizer in band applications below the organic matter which accumulated on the surface of no-till corn acreage, conserves soil moisture and reduces soil erosion. The result is a savings of up to 25 pounds per acre of nitrogen, worth over \$2 million annually.

- o Florida State Agricultural Experiment Station poultry scientists are developing a feeding system for frying chickens (broilers) that shows promise for reducing the amount of abdominal fat. All parties benefit--the consumer will buy less fat and have less cooking loss, the poultry processor will realize higher dressing percentages, the producer will save feed.
- o A new shipping fever vaccine developed by Ohio State Agricultural Experiment Station scientists has been made available to the cattle industry. This disease is the animal health problem of greatest concern to beef cattle producers. Shipping fever costs the Nation's beef industry at least \$20 per head annually. The new vaccine is considered to be the first effective preventative for shipping fever.
- o The Food and Nutrition Service, in coordination with the Department of Health and Human Services, sponsored a nationwide video-conference on maternal and infant nutrition. Two videotapes were developed on topics of substance abuse (alcohol, smoking, caffeine) during pregnancy and breastfeeding.
- o Economic Research Service analysis of possible outcomes of a new U.S.-USSR long-term agreement showed that the Soviets would most likely accept more U.S. corn and wheat with possible minimum import commitments ranging up to 20 million tons and that such quantities could be guaranteed to the USSR without disrupting the U.S. domestic economy. Further analysis of USSR agricultural policy provided the backdrop necessary for an effective interagency formulation of U.S. negotiating strategy.
- o The Statistical Research Service's area survey data was used with LANDSAT 4 data to calculate improved crop acreage estimates for Arkansas, Colorado, Kansas, Missouri, Oklahoma, Iowa, and Illinois in 1983. Significant improvements in methodology have been made in the last decade. This is reflected in the cost of applying this technology to make current crop acreage estimates. Per state, costs were reduced from \$300,000 in 1978 to about \$120,000 in 1983.
- o Forest Service researchers have lowered the cost of controlling kudzu--an imported vine pest--from \$150/acre to as little as \$75/acre through herbicide techniques developed at the Southern and Southeastern Forest Experiment Stations. Researchers screened over 25 herbicides to find a cheap, effective formulation and developed a ground application system suitable for nonindustrial forest landowners.
- o Extension Service-USDA developed microcomputer software programs in cooperation with Texas A&M University to assist farmers with their decisions on crop insurance. Extension and the Federal Crop Insurance Corporation held four regional workshops to train Extension specialists in use of these computer programs. The workshops enabled State specialists to train county staff who assisted farmers in making decisions on crop insurance needs for 1983. In addition, Extension conducted an expanded educational program to assist farmers in understanding the use of crop insurance as a risk management tool.



Future long-term needs and directions in the food and agricultural sciences appear in two comprehensive reports prepared in 1982 and 1983 under the supervision of the Joint Council on Food and Agricultural Sciences. These reports are: (1) Needs Assessment for Food and Agricultural Sciences and (2) Five-Year Plan for Food and Agricultural Sciences. Copies of these reports are available from Executive Secretary, Joint Council on Food and Agricultural Sciences, Room 321A, Admin. Bldg., U.S. Department of Agriculture, Washington, D.C. 20250.

Also, in 1983, research administrators in the Federal/State Agricultural Research System were asked by the Joint Council to identify changes they would make in the use of research resources by 1988. Assuming no increase in total resources over the 1983-88 period, shifts would be made to increase work in more than 30 research programs (RPs). The most increase in scientist years would be in RPs covering Soil and Land Use, Water/Watersheds, Marketing Competition, Vegetable Crops, and Farm Adjustments, Price and Income. These and other changes in research and the future emphasis in Cooperative Extension programs are described in the last section of this report.



FEDERAL, STATE, AND PRIVATE INDUSTRY SUPPORT FOR  
THE FOOD AND AGRICULTURE SCIENCES

Department of Agriculture

The U.S. Department of Agriculture's research and education (R&E) agencies supported food and agriculture research, extension, and teaching programs funded at approximately \$1.208 million in FY 1983, up 5.8 percent from FY 1982. These programs were centered in the Agricultural Research Service (ARS), Cooperative State Research Service (CSRS), Extension Service (ES), National Agricultural Library (NAL), Forest Service (FS), and Economic Research Service (ERS). Other agencies having research and education activities include the Agricultural Cooperative Service (ACS), Agricultural Marketing Service (AMS), Human Nutrition Information Service (HNIS), Office of International Cooperation and Development (OICD), Office of Transportation (OT), and Statistical Reporting Service (SRS). USDA research and education program funding for Fiscal Year 1984 is estimated to be \$1.242 million (table 1).

The research and education (R&E) programs of the Department are complementary and mutually supportive in providing new knowledge, technology, and information on food, agriculture, and forestry issues vital to producers, marketing firms, consumers, and action agencies. The results of these efforts affect the total economy of the United States and millions of consumers here and abroad. Including production, processing, and marketing, the agriculture and forestry sectors account for approximately 25 percent of gross national product and 25 percent of employment in the United States. These sectors also provided \$18.4 billion in export trade surpluses in FY 1983, which helped to offset huge trade deficits in other categories.

USDA research programs address national issues in production efficiency, export markets, marketing efficiency, natural resources management and conservation, human and community development, and human nutrition. Research programs financed by the Department encompassing this complex array of issues, represented 2.2 percent of the FY 1983 Federal research funding of \$38.9 billion.

The Secretary of Agriculture has identified research and extension as one of his five major goals. The research and education programs provide major underpinnings for the remaining goals of the Secretary which are: (1) a strong, healthy agricultural economy; (2) food and fiber for peace and economic stability; (3) resource conservation; and (4) support for State and local governments.

Over the past decade, funding for USDA Research and Education programs has grown significantly in current dollars - from \$595 million in FY 1974 to \$1,242 (estimated) for FY 1984 (table 1). However, the gain in current dollars for research and education was more than offset by inflation over the period. In constant 1972 dollars, funding actually declined slightly, from \$518 million in FY 1974 to \$507 million in FY 1984.

The trend in overall R&E funding in constant dollars over the decade exhibited increases in most years through 1979 and declines in 4 out of 5 years since that time. Funding for research exhibited much the same trend, while funding for

education in constant dollars declined in all but 2 years from 1974 to date (fig. 1).

Differences in funding were apparent among the R&E agencies. Approximately half the agencies operating R&E programs over the 1974-84 period had funding increases more than sufficient to cover inflation while the other half did not (table 3).

## USDA Research and Education Programs Budget Appropriations (1972 Constant Dollars)

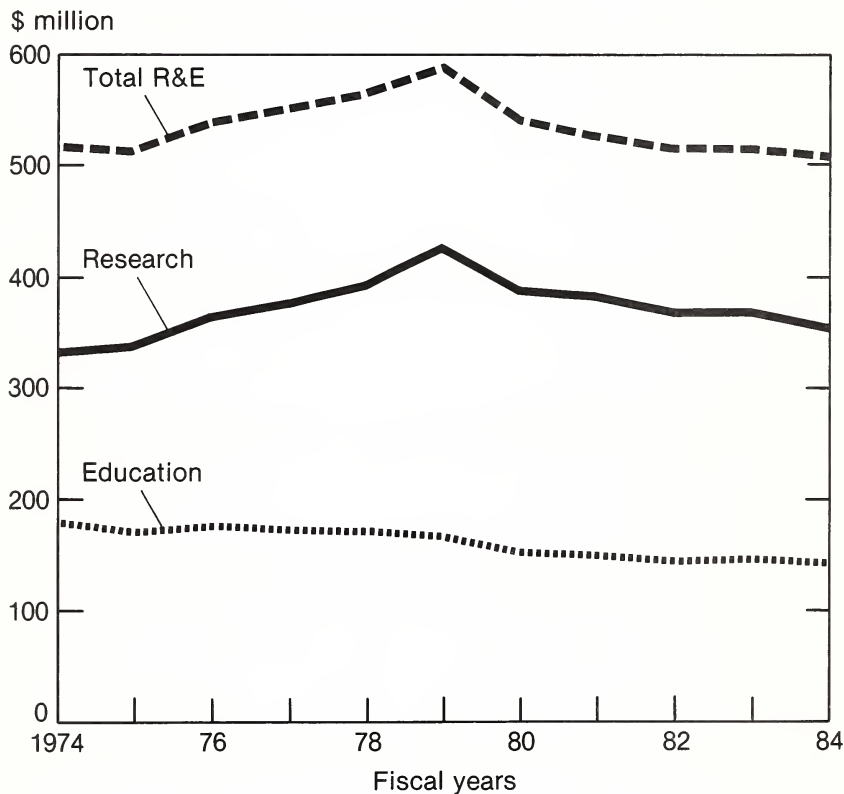


Table 1 USDA Research and Education Programs by Agency  
Budget Appropriations in Current Dollars  
FY 1974 - 1984

Agency	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984 1/
<u>Million dollars</u>											
<u>Research</u>											
Agricultural Research Service2/	205.13	218.03	252.91	282.46	315.88	376.16	370.57	414.73	425.68	454.38	472.41
Cooperative State Research Service	90.11	101.75	114.46	129.02	143.15	174.40	186.03	200.90	221.22	244.95	247.66
Human Nutrition Information Service3/	--	--	--	--	--	--	--	--	9.20	8.15	6.56
Economic Research Service	20.19	23.07	26.27	28.51	32.06	33.96	35.18	38.13	37.97	38.93	43.84
Statistical Reporting Service	.90	1.20	1.80	2.20	2.20	2.30	6.00	7.50	7.00	7.90	8.20
Agricultural Cooperative Service	1.40	1.20	1.30	1.30	2.20	2.20	1.60	1.80	1.70	2.20	2.20
Agricultural Marketing Service4/	--	--	--	--	--	1.24	1.29	1.42	1.46	1.54	1.54
Office of Transportation3/	--	--	--	--	--	--	--	.90	.90	.90	.90
Office of Int'l. Cooperation & Dev.	5.00	5.00	7.50	7.50	5.75	5.75	5.24	5.24	.73	5.33	5.38
Forest Service	63.79	77.61	82.28	89.79	105.79	110.95	111.53	127.81	112.15	106.67	108.56
Total Research	386.52	427.86	486.52	540.78	607.03	706.96	717.44	798.43	818.01	870.95	897.25
<u>Education</u>											
Extension Service	204.07	215.52	228.94	241.91	257.56	263.90	274.04	292.27	315.70	328.65	334.34
National Agricultural Library	4.51	4.92	5.54	6.19	7.11	7.53	7.92	8.82	8.05	8.73	10.38
Total Education	208.58	220.44	234.48	248.10	264.67	271.43	281.96	301.09	323.75	337.38	344.72
Total USDA Research and Education	595.10	648.30	721.00	788.88	871.70	978.39	999.40	1,099.52	1,141.76	1,208.33	1,241.97

1/ Estimated. 2/ Figures do not include appropriations for construction. 3/ Agency established 1981. 4/ Research unit established in 1979.

Table 2. USDA Research and Education Programs by Agency  
Budget Appropriations in Constant 1972 Dollars<sup>1/</sup>  
FY 1974 - 1984

Agency	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
<u>Research</u>											
Agricultural Research Service <sup>2/</sup>	178.53	173.04	189.45	197.80	206.32	228.25	200.09	199.97	192.09	194.51	192.82
Cooperative State Research Service	78.42	80.75	85.74	90.35	93.50	105.83	100.45	96.87	99.83	104.86	101.86
Human Nutrition Information Service <sup>3/</sup>	--	--	--	--	--	--	--	--	4.15	3.49	2.68
Economic Research Service	17.57	18.31	19.68	19.96	20.94	20.61	18.99	18.38	17.14	16.67	17.89
Statistical Reporting Service	.78	.95	1.35	1.54	1.44	1.40	3.24	3.62	3.16	3.38	3.35
Agricultural Cooperative Service	1.22	.95	.97	.91	1.44	1.33	.86	.87	.77	.94	.90
Agricultural Marketing Service <sup>4/</sup>	--	--	--	--	--	.75	.70	.68	.66	.66	.63
Office of Transportation <sup>2/</sup>	--	--	--	--	--	--	--	.43	.41	.39	.37
Office of Int'l. Cooperation & Dev.	4.35	3.97	5.62	5.25	3.76	3.49	2.83	2.53	.33	2.28	2.20
Forest Service	55.52	61.60	61.63	62.88	69.10	67.32	60.22	61.62	50.61	45.66	44.31
Total Research	336.39	339.57	364.44	378.69	396.50	428.98	387.38	384.97	369.15	372.84	366.23
<u>Education</u>											
Extension Service	177.61	171.05	171.49	169.40	168.23	160.13	147.97	140.92	142.46	140.69	136.47
National Agricultural Library	3.93	3.90	4.15	4.33	4.64	4.57	4.28	4.25	3.63	3.74	4.24
Total Education	181.54	174.95	175.64	173.74	172.87	164.70	152.25	145.17	146.09	144.43	140.71
Total USDA Research and Education	517.93	514.52	540.08	552.43	569.37	593.68	539.63	530.14	515.24	517.27	506.94

<sup>1/</sup> Deflator used for 1974 through 1982 was implicit price deflator for Federal Government purchases of goods and services (BEA, U. S. Department of Commerce). Estimated from 1983 - 1984, 233.6 and 245.0, respectively.

<sup>2/</sup> Figures do not include appropriations for construction. <sup>3/</sup> Agency established 1981. <sup>4/</sup> Research unit established in 1979.

Table 3 USDA Research and Education Programs  
by Agency  
Percentage Change in Budget Appropriations FY 1974-84  
Constant 1972 and Current Dollars

<u>Research</u>	<u>Constant 1972 Dollars</u> (Percent)	<u>Current Dollars</u>
Agricultural Research Service	+8.0	+130.3
Cooperative State Research Service	+28.9	+174.8
Human Nutrition Information Service	NA	NA
Economic Research Service	+1.8	+117.1
Statistical Reporting Service	+329.5	+811.1
Agricultural Cooperative Service	-26.2	+108.1
Agricultural Marketing Service	NA	NA
Office of Transportation	NA	NA
Office of Int'l. Cooperation & Dev.	-49.4	+7.6
Forest Service	<u>-20.2</u>	<u>+70.2</u>
Total Research	+8.9	+132.1
<u>Education</u>		
Extension Service	-23.2	+63.8
National Agricultural Library	<u>+8.2</u>	<u>+130.2</u>
Total Education	-22.5	+62.5
Total USDA Research and Education	-2.1	+108.7

Note: NA means not applicable.

## Other Federally Supported R&E in Food and Agriculture

Federal departments and independent agencies other than USDA devoted \$581.2 million for domestic programs related to food and agriculture research, extension, and teaching programs in 1981. (While no complete inventory is available for 1983 it is estimated that total funding was approximately the same.) These funds were distributed to major program areas as follows:

Program Area	<u>Research:Extension:Total</u>		
	-----Million dollars-----		
Natural Resources <sup>1/</sup>	187.4	4.0	191.4
Production and Protection	100.9	19.2	120.1
Processing, Marketing and Distribution	63.1	1.7	64.8
People and Communities	168.0	35.5	203.5
Agricultural Policy	1.4	-	1.4
Total	520.8	60.4	581.2

<sup>1/</sup> Includes soil and water and forest, range, and wildlife programs.

Departments and agencies supporting these related programs include:

- o U. S. Department of Commerce
  - National Oceanic and Atmospheric Administration (NOAA)
  - Science and Technical Research
- o U. S. Department of Defense
  - Army Corps of Engineers
  - Research, Development, Testing and Evaluation
- o U. S. Department of Education
  - Postsecondary Education
- o Department of Energy
- o Environmental Protection Agency
  - Research and Development
- o U. S. Department of Health and Human Services
  - Alcohol, Drug Abuse, and Mental Health Administration
  - Bureau of Foods, FDA
  - Bureau of Veterinary Medicine, FDA
  - Centers for Disease Control
  - Health Resources Administration
  - Health Services Administration
  - National Center for Health Statistics
  - National Institutes of Health



- o U. S. Department of Interior
  - Bureau of Land Management
  - Bureau of Mines
  - Bureau of Reclamation
  - Fish and Wildlife Service
  - Geological Survey
  - National Park Service
  - Office of Surface Mining
- o International Trade Commission
- o U. S. Department of Labor
- o National Aeronautics and Space Administration
  - Space and Terrestrial Applications
- o National Science Foundation
- o Tennessee Valley Authority
- o U. S. Department of Treasury
  - Internal Revenue Service
- o Veterans Administration

About 65 percent of the work was conducted through contracts and grants with universities and other institutions. The remaining work was conducted in federally owned and operated laboratories. These programs relate to both the action missions of sponsoring agencies and separate science and education missions. A more complete analysis of these activities is available upon request to: Executive Secretary, Joint Council on Food and Agricultural Sciences, Room 321A Administration Building, U. S. Department of Agriculture, Washington, D.C. 20250.

#### State Support

State support for research, extension, and higher education for the food, fiber, and forestry system approximately equals that of the Federal contributions--about \$1.3 billion. Combined Federal and State funds support about 11,000 scientists and 17,000 extension personnel who are the formulators and extenders of knowledge needed by the Nation's largest industry. Public investment in food and agriculture research and education has consistently provided annual returns of 30 percent or more.

State support for the food and agricultural sciences is provided primarily through the Land-Grant Institutions (1862, 1890, Forestry Schools, and Tuskegee Institute) and includes funds for research, extension, and higher education. However, there are an estimated 50 State-supported, nonLand-Grant Institutions that also have agricultural programs. These programs are primarily devoted to higher education.

### Private Industry R&D

Estimated industry expenditures for R&D in agriculture and forestry were \$1.8 billion in 1979. While no update is available, these expenditures probably did not change greatly over the 4-year period. Increases which would normally be expected are likely to have been offset by declines in R&D spending by some agricultural industry firms because of depressed earnings in recent years. Shifts in type of research funded by industry may have changed, with large percentage increases in biotechnology research offsetting declines in more traditional lines of research such as that conducted by equipment and fertilizer manufacturers.

National Science Foundation studies show that at the farming level, 75 percent of the industrial research expenditures are for pesticides, drugs, and farm equipment and machinery--areas of unique concern to suppliers of farm production inputs. At the post-farming level, the emphasis is on food processing, machinery, and packaging. At the time the 1979 report was prepared, directors of several large research laboratories were contacted to determine the type of research undertaken by the private sector. In general, they stated that industry managers had little motivation for expending resources to better understand basic biological and physical processes. They generally depend on public-sponsored research at universities and within USDA for this knowledge. Unless R&D results can be patented and used in a company product in a fairly short time period, private firms are reluctant to finance the research.

### Basic Research Outlays

In recent years, USDA agencies and cooperating institutions which support and conduct basic research have increased the proportion of their total outlays going into this area (table 4). For example, from FY 1978 to FY 1983, the Forest Service increased the percentage of outlays devoted to basic research from 30 to 36 percent. The Agricultural Research Service increased outlays for basic research from 41 to 49 percent of total research outlays over the same 5-year period.

Overall, the percentage of research funds devoted to basic research by USDA agencies and cooperating institutions was 40 percent in FY 1983. Private industry support for basic agricultural research is estimated to continue at about 10 percent of total outlays.

Table 4--USDA and Cooperating Institutions Outlays for Basic, Applied, and Developmental Research (FY 1983)--With Comparisons

Performing Organization	Basic Research	Applied Research	Develop- mental Research	Total	Basic1/ FY1983 FY1978	
		Million dollars			Percent	
Agricultural Research Service..	211.6	199.1	25.0	435.7	49	41
Cooperative State Research.....	100.6	134.3	-	234.9	43	42
Human Nutrition Information Service.....	-	7.7	.5	8.2	-	-
Economic Research Service	3.9	35.1	-	39.0	10	NA2/
Statistical Report- ing Service.....	2.6	5.3	-	7.9	33	NA2/
Agricultural Cooperative Service.....	-	1.7	-	1.7	-	-
Agricultural Marketing Service.....	-	1.2	.3	1.5	-	-
Office of Transportation....	.5	.3	.1	.9	56	NA2/
Office of Int'l Cooperation and Development.....	2.7	2.6	-	5.3	1	NA2/
Forest Service.....	<u>38.8</u>	<u>65.1</u>	<u>3.8</u>	<u>107.7</u>	<u>36</u>	<u>30</u>
Subtotal 3/.....	360.7	452.4	29.7	842.8	43	NA2/
Cooperating 4/ Institutions.....	<u>317.2</u>	<u>475.9</u>	<u>65.2</u>	<u>858.3</u>	<u>37</u>	<u>34</u>
Total	677.9	928.3	94.9	1,701.1	40	NA2/

Dashes mean none.

Footnotes for Table 4

- 1/ According to the "1975 Survey of U. S. Agriculture Research by Private Industry," conducted by the Agricultural Research Institute, 151 companies indicated that 10 percent of their research was basic.
- 2/ Not available.
- 3/ USDA agencies.
- 4/ Estimated other than USDA Federal funding and non-Federal funding at CSRS cooperating institutions. Includes SAES, 1890 Colleges and Tuskegee Institute, forestry schools, colleges of veterinary medicine, and other cooperating institutions.

## SIGNIFICANT ACTIVITIES AND ACCOMPLISHMENTS IN THE FOOD AND AGRICULTURAL SCIENCES

The following represent significant activities and accomplishments in food and agricultural research and education performed and/or funded by each of 12 USDA agencies. Not intended to be comprehensive, the agency reports provide an overview of significant developments during FY 1983.

### Agricultural Research Service (ARS)

#### Significant Activities

- o Program Planning - A comprehensive program plan and 6-year implementation plan were reviewed and discussed with appropriate members of Congress, university cooperators, commodity groups, and others. This planning effort has identified high priority national research needs and will guide ARS activities in future years. It will be updated annually to assure that all research is current and meets the needs of the Nation.
- o High Priority Problem Solving Research - ARS took the initiative to redirect resources to the highest priority national research needs. Shifts in emphasis resulted in closure of six small research locations. Total program adjustments approximate \$36 million.

#### Accomplishments

- o A New and Sensitive Method for Vitamin D Analysis. A highly sensitive, precise analytical technique can accurately measure vitamin D in milk, blood, and tissues of animals and man. Concentrations of vitamin D in blood and tissues previously had to be estimated by inoculating live animals. Use of this new laboratory technique, developed by ARS scientists, opens new research avenues to understanding the role of vitamin D in metabolic diseases of the kidney, bone, and intestine of animals and humans.
- o Predicting the Effect of Control Methods on Insect Annoyance, Damage, and Disease Transmission. Data accumulated over many years on the biology, ecology, and dynamics of insect populations, the effects of control methods on insects, and the development and epidemiology of diseases such as malaria and river blindness have been used to develop a computer simulation technique. The simulation predicts insect population density over extended periods of time and the prevalence and incidence of disease related to the density of insects. Such simulations have been developed for mosquitoes, flies, and ticks, and

diseases such as malaria, dengue, and river blindness. Simulations have been adapted to analyzing the effects of control methods, such as pesticides, biological control, attractants, and sterile insect releases, on both the density of insects and the transmission of disease. The simulation technology is ideal for training and educational purposes as well as planning research and operations.

- o Tung Oil Found to Increase Effectiveness of Herbicides. Research has demonstrated that tung oil adds controlled release properties to herbicides. It dries rapidly by polymerization and can be used to encapsulate herbicides directly on the seed coats of crop seeds or in a hard glossy matrix on inert granules. Several herbicides formulated in tung oil and applied directly to the seed coats of crop seeds at extremely low rates per acre have given excellent weed control without crop injury. Other agricultural chemicals such as germination stimulants, fungicides, growth regulators, and biocontrol organisms can also be encapsulated onto the coats of crop seeds or granules using tung oil. The addition of layers of combinations of such active ingredients on the seed coats of crop seeds and controlled-released granules has been achieved. Farmers can practice this technology using farm-produced materials, thus greatly reducing costs of transportation and storage.
- o Fructose Consumption Undesirable for Carbohydrate-Sensitive People. Fructose is entering the U.S. food supply in increasing amounts as a sweetener in processed foods. Accordingly, a study was conducted to determine the effect of high intakes of fructose on human health, using normal and carbohydrate-sensitive adult human male subjects. Including of fructose in the diet increases the blood lipids, high levels of which are considered to be a risk factor in heart disease. Glucose tolerance also appeared to be impaired with high fructose levels. Carbohydrate-sensitive men exhibited greater effects than did normal men. The results indicate that individuals who are carbohydrate-sensitive (9 to 16 percent in U.S.) should avoid excessive consumption of foods containing high levels of fructose.
- o Bioregulation of Specific Gene Expression in Barley. Knowledge of gene structure and bioregulation of its activity are the key for introducing the concept of "hormonal balance" as an important trait in crop production and marketing strategy. Seed scientists at Beltsville, Maryland, have demonstrated that the plant hormone, gibberellic acid, controls the denovo synthesis of alpha-amylase messenger RNA, a first step in producing this enzyme which is important to malting quality of barley.
- o Novel Process for Poultry Meat Removal. A method to remove the breast and leg meat from noneviscerated poultry in a highly sanitary manner has been developed by scientists at the Russell Research Center in Athens, Georgia. The high labor and equipment costs of evisceration and most of the energy costs for initial carcass cooling would be eliminated if this method is implemented in commercial slaughter plants.

- o Selection in Tissue Cultures Can Identify Useful Genetic Variants for Crop Improvement. Plants resistant to the toxin produced by the fungus Helminthosporium victoriae, which causes victoria blight in oats, were recovered from tissue cultures from a susceptible oat line. All progeny of these plants were also resistant, indicating that the trait is heritable. This is the first example of the selection of a stably inherited trait in oats through the use of tissue cultures and one of the first examples in the cereal crops.
- o Genetic Engineering on Viroid Has Led to Practical Commercial Use. An inexpensive and extremely sensitive diagnostic test for the presence of viroids in potatoes has been devised. This test is being used in several countries to ensure disease-free seed potatoes. The new test is based on a reaction that occurs between the viroid present in plant sap and genetically engineered DNA. In another line of research on potato spindle tuber viroids, recombinant DNA clones, containing cDNA inserts of the viroid, have been found to be infectious. This work on pathogen genetic modification offers a molecular basis for understanding host-pathogen interactions and allows construction of a complete genetic map of the viroid.
- o Rangeland Model Completed. The components of the SPUR (Simulation of Production and Utilization of Rangelands) model were completed and interfaced in preparation for testing, evaluation, and refinement. SPUR considers climate, soils, hydrology, plants, grazing animals, insects, economics, and their interactions. The two versions of SPUR, a pasture scale version and a basin scale version, will provide a wide spectrum of simulations to enhance both management and research in rangeland ecosystems.

#### Cooperative State Research Service (CSRS)

##### Significant Activities

- o Discipline and Program Reviews. CSRS conducted 69 special reviews in the State Agricultural Experiment Station System, 1890 Institutions, and Forestry Schools using peer panels to evaluate research productivity, program direction, and future research opportunities. State Agricultural Experiment Station Administrators, Administrative-Technical Representatives, and 1890 Directors met in regional and national meetings to coordinate research administration and to focus on emerging research needs and direction. In addition, 231 regional-technical committees conducted meetings to coordinate interstate and interregional research on problems of mutual interest.
- o National Pesticide Information Retrieval System. A computerized system that retrieves up-to-the-minute facts about registered pesticides across the country began operation October 10, 1983. The system, developed at Purdue University, in cooperation with USDA, provides, through a computer network, the latest information about key characteristics of

pesticide products registered by the U.S. Environmental Protection Agency and participating State regulatory agencies. The service is available to member organizations such as land-grant universities, State and Federal regulatory offices, State and Federal scientists, the pesticides industry, user groups and organizations, and others working on pesticide-related activities.

- o Administration of Research Facilities Program with the 1890 Institutions and Tuskegee Institute. This program was funded in FY 1983 at \$10 million. Each of the 17 institutions submitted to CSRS a Five-Year Action Plan for the Development of Research Facilities. A grant was awarded to each institution which authorized the expenditure of FY 1983 funds for the upgrading of research facilities. CSRS obligated all funds to the colleges before the end of FY 1983. For FY 1984, \$10 million has been appropriated and declared to be no-year funds.
- o Planning Efforts for Forestry Research Are Coordinated with Resources Planning Act. CSRS, the schools in the Cooperative Forestry Research Program, and the USDA's Forest Service have embarked upon an effort to use research scientists' and administrators' opinions to rank research to be accomplished in 1985-90. This information will constitute a part of the program planning activity required of the Forest Service under the Resources Planning Act (RPA). It involves techniques used in the U.S. Department of Defense, where the expected value of choosing various courses of action is uncertain. Initial information has been obtained by all Forest Service Stations, and CSRS staff members are working with administrators at the participating forestry schools to obtain their input. Completion of the effort will result in a joint publication of the planned research for the next program planning period.
- o Program Analysis and Evaluation. A joint CSRS-ES study of university-based research and extension programs in natural resources was initiated by cooperative agreement with Colorado State University. Although the Program Analysis and Evaluation Staff was abolished in a reduction-in-force, CSRS continued the program analysis and evaluation studies and activities that were underway.

#### Accomplishments

The State partner institutions of USDA conduct research and experiments on problems related to the development of a permanent and sustaining system of agriculture and forestry, and improvement of the economic and social welfare of rural families. The following examples are some of the many research accomplishments being funded at least partially through CSRS-administered funds.

- o Hatch Act Research. The Hatch program of research at the State Agricultural Experiment Stations is aimed at improving rural living conditions, conserving resources, and promoting efficient production,



marketing, distribution, and use of crops and livestock essential to the food supply, health, and welfare of the people of the United States.

- Evaluating Water Stress and Plant Genetic Interactions Simplified. The line source irrigation sprinkler, developed by the Utah Agricultural Experiment Station, is being used worldwide to help plant breeders and soil scientists evaluate promising crop lines more quickly under conditions of varying water availability and drought stress. This sprinkler design allows for the simultaneous evaluation of breeding line responses to excess irrigation, both near the sprinkler line and near dryland several meters away from the sprinkler line. Thus, excess irrigation, full irrigation, several levels of limited irrigation, and dryland can be tested at one time. This system can demonstrate visually the effects of variable irrigation on yield or yield parameters.
- Whole-Field Statistical Analysis for Agricultural Management Research. Scientists at the California State Agricultural Experiment Station, as part of a regional research project, have devised statistical methods for studying treatment effects on whole agricultural fields. Rather than small plots, located on representative areas, and receiving somewhat arbitrary treatments, geostatistic methods allow entire fields to be analyzed by taking advantage of the inherently heterogeneous character of soil properties. Soil properties are spatially dependent (varying in a predictable manner from one location to another within a field). So these statistical techniques allow analyses of research that provide better data for field-scale management decisions and results can be used to maximize crop yields on an annual basis and to improve and conserve the quality of agricultural lands over a long period of time.
- Reduction in Use of Commercial Nitrogen Fertilizer. Many State Agricultural Experiment Stations (SAES) are conducting studies to reduce the use of commercial nitrogen fertilizer, reduce production costs, and conserve natural resources, while producing optimum yield of crops. The Alabama SAES has developed two new sericea lespedeza perennial legumes. These have high digestibility and nutrient qualities, 'Serala' and 'AU Lotan,' which can withstand hot weather, grow in acid soils, and fix nitrogen. Grazing trials using these two legume varieties produced nearly 2 pounds of gain per day on 500-pound steers. Kentucky SAES has shown that placement of nitrogen fertilizer in band applications below the organic matter which accumulated on the surface of no-till corn acreage, has several good results. It conserves soil moisture, reduces soil erosion, and permits savings of up to 25 pounds per acre of nitrogen, worth over \$2 million annually.
- Controlling Composition and Cost of Meat. Nebraska State Agricultural Experiment Station meat scientists have conducted basic research on meat manufacturing, restructuring, and processing that is changing the food industry. They have developed processes for using the cheaper cuts and trimmings of meat. These are restructured into firm,

palatable, uniform, steak-like cuts. Restructured meat can be particularly useful in institutional meal service where requirements for uniformity of quality, shape, and size of portion are paramount. This technology is being adopted by the food industry and the military.

- o McIntire-Stennis Research. The Cooperative Forestry Research (McIntire-Stennis) program is planned and directed to provide answers for forest land managers seeking to produce timber yet preserve wildlife and recreational opportunities in forests.
  - Energy-Efficient Wood Drying. Working with different species in different climatic conditions, two institutions have found ways to dry wood more efficiently. Small sawmill operators can now kiln-dry lumber profitably with a commercially sized solar heated kiln developed by researchers at the University of Montana. They can dry wood in the summer on schedules comparable to fossil-fueled kilns at 25 percent of the cost of drying with fossil fuels. The kiln is inexpensive to build and maintain. For small mills, the profitability of the solar kiln is substantial. For large mills, the kiln can be used as a pre-drier. At Mississippi State University, scientists have developed a procedure for drying dimension lumber with superheated steam. This system would use approximately one-fourth less energy than present systems and produce straighter, more uniformly dried lumber. Such reductions in energy use further enhance the competitive advantage of a renewable resource.
  - Losses Due to Compaction by Logging Vehicles--A Manageable Problem. Working with True Fir on California soils, forest scientists at the University of California have found that soil bulk density has more than doubled on skid trails and landings. This finding has led to quantifiable measures of the decreased yield due to reduced growth of individual trees and to a smaller number of trees becoming established. With different soils and species, researchers at Oregon State University have established that such compaction problems last 30-50 years, particularly on the best sites. The forest engineers at Oregon State designed logging systems that reduce compaction to manageable proportions. Federal forestry agencies are again willing to offer sales based on tractor logging, significantly reducing costs to taxpayers on several million acres of forest land. In one 40-acre unit, for example, lumbermen could use designed skid trails instead of an expensive skyline, and reduced harvesting costs by \$50,000. Multiplied by the hundreds of operations in the region each year, the net benefit of this research is substantial.
- o Evans-Allen Research. This formula-funded research program for the 1890 Colleges and Tuskegee Institute was established by the Food and Agriculture Act of 1977. Annual appropriations support continuing agricultural research.

- Less Fat in Frying Chickens. Florida State Agricultural Experiment Station poultry scientists are developing a feeding system for frying chickens (broilers) that shows promise for reducing the amount of abdominal fat. Restricting calorie intake during the last 10 days before the birds are marketed lowers the amount of abdominal fat. Doing so did not increase the cost of producing edible, ready-to-cook poultry meat. Consumers benefit from buying less fat and lose less in cooking, the poultry processor realizes higher dressing percentages, and the producers save feed.
- Distribution and Control of Soybean Nematodes. Research conducted by the Southern University on the distribution of soybean parasitic nematodes in Louisiana showed that 13 parasitic nematodes were closely associated with soybean roots. The area of infestation by parasitic nematodes, especially soybean cyst nematode (*Heterodera glycines*), is enlarging rapidly in Louisiana. In many parishes, two or more species of nematodes were infecting soybean cultivars at the same time. Application of nematicides, insecticides, and fungicides for control reduced nematode numbers for all treatments at the flowering period of soybeans. But the populations increased to a high level at the end of the growing season. This research will assist in identifying the distribution of and damage caused by nematodes to soybeans in Louisiana. Soybeans are currently the State's leading cash and export crop.
- o Special Research Grants. The Special Research Grants program concentrates on problems of national interest beyond the emphasis given to these problems in the formula grant programs.
  - Kinship Ties Related to Soil Erosion Control. "Farming with a relative" is highly related to the use of approved soil erosion control practices, according to researchers at the Idaho and Washington State Agricultural Experiment Stations. In the Palouse area of Washington and Idaho, father-son farm operators seem to be more sensitive to maintaining soil productivity for future generations than farmers with no kinship ties in their farm operations. In addition, farmers who expect their children to become farmers are more likely to use erosion control practices than those who expect their children to go into other occupations. Thus, the continuation of the family farm may be important not only for providing income and a desired lifestyle, but also for protecting the productive resources of the soil.
  - Rapid Diagnosis of Johne's Disease in Cattle. Oregon and Colorado scientists have made very significant findings toward the development of tests to permit rapid, positive identification of cattle infected with Johne's Disease. Once established in a herd, this costly disease is hard to eradicate. The lengthy process begins with diagnosis of infected animals, which requires culture tests of 12 to 16 weeks' duration to detect the causative bacterium. Combined losses in 1982

for Minnesota, Oregon, and Wisconsin were estimated at \$118 million. The Oregon and Colorado scientists are developing tests derived from purified extracts of Mycobacterium paratuberculosis, the causative agent. They have established that a specific fatty acid is found only in this bacterium. The final step now underway is to incorporate this substance into tests for detecting the disease.

- Tolerance Levels for Pesticide Residues Established. Research conducted or coordinated by the IR-4 regional laboratories at the California, Florida, Michigan, New Jersey, and New York Agricultural Experiment Stations has provided data that support 82 safe tolerance levels for pesticide residues in food or feed crops established by the EPA during the past year. These tolerances allow pesticide protection for fruit, vegetable, nut, and feed crops valued at more than \$15 billion annually thus benefiting farmers, ranchers, and consumers.
- o Animal Health and Disease Research. The Animal Health and Disease Research (Section 1433, Public Law 95-113) formula program is directed to improving the health and productivity of animals and the welfare of producers and consumers of animal products; protecting human health through control of animal diseases transmissible to humans; minimizing livestock and poultry losses due to transportation and handling; and facilitating the effective treatment and prevention of animal diseases.
- Molecular Basis for Genetic Resistance to Disease in Cattle. Texas scientists are studying basic mechanisms occurring in genetic resistance to disease in cattle. They and others have found that this hereditary resistance involves two fundamental mechanisms. One mechanism is centered in receptors for cellular attachment and penetration by disease microorganisms. The other involves interferons--a family of protective proteins produced by cells reacting to disease agents. The Texas scientists have identified in cattle two classes of genes, one of which regulates cell receptor protection against viral infection. The identification of structural genes responsible for these two important resistance factors will make possible the screening of cattle for genetic resistance with selective breeding of resistant animals.
- Vaccines for Control of Mycoplasmosis in Poultry. University of Georgia scientists have developed a vaccine which produces significant protection against egg transmission of mycoplasmosis, a serious cause of poultry respiratory disease and reduced productivity. Another vaccine gives significant protection against egg production losses from mycoplasmosis in commercial egg pullets. These vaccines are reducing the 10 to 15 percent egg production losses caused by mycoplasmosis and are helping to lower the estimated annual loss of \$97 million from this disease in commercial layers.
- New Shipping Fever Vaccine. The product of more than 6 years of research by Ohio State Agricultural Experiment Station scientists recently was made available to the cattle industry in a new vaccine

thought to be the first effective preventative of shipping fever. The causative bacterium is injected between the layers of the skin. It has been tested in an estimated 10,000 animals with no adverse effects. This disease has been the animal health problem of greatest concern to beef cattle producers. Shipping fever costs the Nation's beef industry at least \$20 per head annually.

- o Competitive Research Grants. The Competitive Research Grants Program funds basic research in selected high-priority areas related to plant production and human nutrition.
  - In Vitro Culture of Cool-Season Forage Grasses. Research at the University of Tennessee developed a genotype or strain of orchard-grass which produces embryo directly on the surface of leaf segments cultured on a special formulation of salts, hormones, and sugar. This discovery of direct embryogenesis from leaf cells is a first for species in the grass family and constitutes a significant step in biotechnology applications for these important crop plants. The ability to grow whole plants from single cells is a necessary component of the new "genetic engineering" or "biotechnology" that is expected to contribute significantly to crop improvement in future decades. Forage grasses, grown on approximately one-half of the open land in Tennessee, support a viable livestock industry. Development of a new genotype or strain of orchard-grass could reduce cost of producing beef cattle 5 percent, a potential saving of about \$15 million annually to the State's farmers.
  - Structural Differentiation and Functional Organization in Higher Plant Chloroplasts. University of California research has shown that two discrete types of particles within the leaf are responsible for oxygen production, an essential part of higher plant photosynthesis. These particles are located laterally along membranes. Various parts of the photosynthetic systems apparently are not held tightly together to allow for electron transport, proton transport, adenosine triphosphatase formation, and other energy conserving processes. The photosynthetic apparatus may shift its components in response to environmental conditions, especially light quality. The finding is a significant step forward in understanding how plants make food from sunlight.
  - Effect of Diet Upon Chemically Induced Carcinomas. University of Illinois research has shown that the trace element selenium can inhibit the growth of a number of transplantable tumors, including canine and human mammary tumor cells. A concentration of approximately 1 microgram of selenium per milliliter inhibited the vast majority of transplantable tumor cells grown in vitro. This concentration is about 4 times higher than the physiological

concentration of human blood selenium, yet well below that reflecting selenosis. Generally, tumor cells are more susceptible to selenium supplementation than are nonneoplastic cells. However, some tumor cells are more susceptible to selenium than are others. Examination of tumor cells revealed that one of the first macro-molecules to be altered is RNA. RNA polymerase activities of cells actually increased in cells grown in media containing supplemental selenium. Selenium can alter the metabolism of 12-dimethylbenz (a) anthracene (DMBA) by slowing the overall metabolism of this carcinogen and changing its metabolites. The changes in DMBA are observed if selenium is added in vitro or in vivo. Other trace elements can alter the metabolism of this carcinogen. These alterations induced by selenium may be associated with reduced susceptibility to cancer.

#### Human Nutrition Information Service (HNIS)

##### Significant Activities

The Agency conducts applied research in food and nutrition to improve professional and public understanding of the nutritional adequacy of diets and food supplies. Other research includes studies of the nutritive value of food and the development of knowledge needed by the American public for making informed choices among a variety of foods.

- o National Nutrition Monitoring System - HNIS conducts studies basic to the initiation of a national continuing survey of individual diets in 1985. Examples: (1) Under the auspices of the Food and Nutrition Board, National Academy of Sciences, HNIS sponsored a workshop and symposium on "Uses of National Survey Data on Food Consumption." Staff solicited, evaluated, and prioritized data requirements of government, academia, the nutrition and health communities, and the private sector. Ways to meet priority needs most effectively in future surveys are being proposed. (2) Staff will update complex databases and coding manuals for converting reported units of food to weight and then to the nutrient content. (3) Staff will design the survey and form the survey questions. (4) HNIS will sponsor work of the Food and Nutrition Board in specifying nutrient levels below the Recommended Dietary Allowances that represent different degrees of risk. These levels will be used to evaluate intakes reported in the survey.
- o National Nutrient Data Bank - HNIS is modernizing and maintaining the Nutrient Data Bank system. Examples: (1) Staff are revising the system to improve its efficiency in handling data and in processing procedures and to make the system interactive. (2) Staff will continue to revise Agriculture Handbook No. 8, "Composition of Foods," by food group. (3) HNIS is conducting studies to provide nutrient data needed to develop a comprehensive coverage of foods and nutrients.



- o Food and Diet Research - HNIS is developing food and nutrition information responsive to needs of food assistance program managers, nutrition educators, and consumers. Examples: (1) Staff are estimating and analyzing the nutrient content of the U.S. per capita food supply each year. (2) Study diet quality and its determinants, such as demographic characteristics of households, frequency of eating out, and use of convenience foods and vitamin and mineral supplements. (3) Conduct special studies to determine dietary levels of sodium, added sugars, cholesterol, and available iron.
- o Nutrition Guidance - HNIS is developing and implementing nutrition guidance concepts and techniques. Examples: (1) Staff will provide technical assistance in preparation of a six-session nutrition education course for consumers to be taught nationwide by local chapters of the American Red Cross starting in the winter of 1984. (2) Staff are developing nutrition education resources for use by low-literacy/low-income adults.

### Accomplishments

- o National Nutrition Monitoring System - Agency staff conducted studies to determine appropriate methods for the first continuing survey of individual intakes, for which fieldwork is scheduled to begin in 1985.
- o National Nutrient Data Bank - The Agency published the revised section of Agriculture Handbook No. 8 on pork products. Also published was "Food Composition Tables for the Near East," prepared cooperatively with the Food and Agriculture Organization of the United Nations.
- o Food and Diet Research - Staff revised and published the USDA family food plans at four cost levels--thrifty, low-cost, moderate, and liberal. They developed and tested 2 weeks of meal plans (menus, food lists, recipes) for the thrifty food plan, which is used as basis for the Food Stamp allotment. These meal plans were used as the centerpiece for seven workshops in a national "Making Food Dollars Count" campaign. Staff also developed procedures, data bases, and instruction manuals for users pilot-testing the Nutrient Standard Menu Planning System. This system provides for manual or computer calculation of the nutritive value of school lunch recipes and meals.
- o Nutrition Guidance and Education Research - In coordination with the Department of Health and Human Services, HNIS sponsored a nationwide video-conference on maternal and infant nutrition. Two videotapes were developed on topics of substance abuse (alcohol, smoking, caffeine) during pregnancy and breastfeeding. Staff provided nutrition technical assistance for a 29-minute videotape "Inside Out, the Story of Food and Fitness," which was developed for the Food and Fitness campaign initiated by the Office of the Secretary.

Significant Activities

- o Domestic Agriculture and Food. ERS conducts research on the basic economic behavior of consumers, agribusiness managers, producers, and others; conducts research on the U.S. agriculture and food system interdependencies with the nonagricultural economy; provides current economic information on commodity markets, input markets, credit, and policy setting; measures performance and well-being indicators of the U.S. food system; and performs staff analyses to support public policy decisionmaking. Involved are analysis of the situation and outlook, assessment of major policy issues, and longer term research and analysis with special emphasis on the structure, conduct, and performance of major sectors of the agriculture and food system. The program is concerned with agriculture as a part of the overall domestic economy and several other areas--domestic agricultural policy, sources and uses of agricultural finance and credit, farm firm behavior, transportation, marketing agricultural and food products, major agriculture and food system indicators, and food demand and food consumption trends and patterns. Other components are the traditional responsibilities of measuring supply capacity and responsiveness of the agricultural sector, measuring agricultural productivity, assessing the situation and outlook for commodities, and assessing the overall performance of the agricultural sector.
- o International Trade. This program has three major components: (1) conduct research to provide understanding and quantification of the economic relationships determining agricultural production, consumption, prices, and trade within and among the countries of the world; (2) monitor current conditions of world agriculture, interpreting implications for U.S. agriculture, and forecasting world agricultural conditions and agricultural trade in the short and medium term; and (3) maintain a capacity for rapid and effective analytical response to requests of the executive and legislative policymaking apparatus of the Federal Government with respect to global agriculture and U.S. agricultural trade.
- o Production Resources. This program of economic research relates to (1) use, conservation, development, and ownership of natural resources; (2) supply of and demand for production inputs; (3) assessment of technology; and (4) enhancement of environmental quality. Emphasis is on national and regional problems of land and water management as they pertain to current and future U.S. agricultural capacity. This program further considers productivity of farm inputs and environmental impacts on and from agriculture. Also involved is natural resource policy, situation and outlook for manufactured inputs, land and water use, farmland values, and the economics of soil and water conservation.
- o Rural America. Researchers support USDA's three rural development roles: (1) administering programs of assistance--loans, grants, and guarantees to individuals, firms, and local government; (2) providing Federal leadership in rural development and acting as an advocate for



rural interests; and (3) devising strategies and setting goals as required by the Rural Policy Act of 1980. Economists and others analyze trends and causes of change in rural population, employment, income, housing, credit, and local government services and finances.

## Accomplishments

### o Domestic Agriculture and Food

- Federal Dairy Program Operations. In cooperation with other agencies, ERS researchers prepared a report mandated by the Agriculture and Food Act of 1981. The report reviewed the economics of the dairy industry, assessed the effects of existing price support and marketing order programs, and analyzed the likely impacts of alternative dairy programs for the remainder of the eighties. During 1983, analysts studied milk price variability, price uncertainty and stabilization, world production and trade of dairy products, changes in the location of milk production in the United States, technological developments in the dairy industry, and the theory of government intervention in dairy markets. A bibliography of studies on dairy policy was also prepared.
- Where the Food Dollar Goes. ERS researchers issued an annual report which traces the difference between what farmers receive for their product and what consumers pay for it. The farm share of the food dollar spent in restaurants is 17 cents, and for food purchased in grocery stores, 34 cents. The remainder of the consumer's food dollar goes to labor, packaging, transportation, and other food processing and distribution services beyond the farm. ERS economists also studied the impact of changes in the farm-to-retail price spread and the farm value of foodstuffs in grocery store food prices. In 8 of the past 10 years, rising farm-to-retail price spreads contributed more to the rise in food prices than did changes in either the farm value or the price of imported food.
- Economic Indicators. ERS provides farmers, agribusinesses, and public policy decisionmakers with information on the past, current situation, and future of agriculture's economic, production, and financial performance, including measures of income and returns to resources used in agricultural production. ERS researchers provided forecasts of the major farm indicators, including cash receipts, government payments, aggregate production expenses, income measures, off-farm income, farm assets and debt, productivity measures, and unit costs of production.

### o International Trade

- Sources of Recent Declines in U.S. Farm Exports. ERS researchers analyzed changes in equilibrium prices and trade quantities of wheat, feedgrains, and soybeans associated with eight factors having a major impact on recent U.S. farm trade. No single factor explained trade changes across all commodities. Income growth (albeit small), population growth, and declining freight rates all tend to increase

U.S. farm exports. Only two factors, foreign indebtedness and exchange rates, were found to reduce U.S. farm exports. The effects of other factors on U.S. exports (USSR animal feed decisions, foreign crop production, and European Community policy) varied by commodity. Generally, however, these factors had a positive impact on U.S. soybeans and soybean meal exports but a negative impact on wheat and feedgrain exports. Over the 2-year period under study, the stronger dollar was estimated to have cost the United States \$6 billion in farm export sales.

- U.S.-USSR Grain Agreement. ERS analysis of possible outcomes of a new U.S.-USSR long-term agreement focused on minimum import commitments by the USSR for corn and wheat, expanding product coverage to include soybeans and meal, and a new escape clause trigger. ERS analysis showed that the Soviets would likely accept more U.S. corn and wheat with possible minimum import commitments ranging up to 20 million tons. Economists found such quantities could be guaranteed to the USSR without disrupting the U.S. domestic economy, and that new commodities--especially soybeans and soybean meal--could be incorporated in an agreement. Further analysis of USSR agricultural policy provided the backdrop necessary for an effective interagency formulation of U.S. negotiating strategy.
- U.S. - European Community Agricultural Trade Confrontations. ERS analyzed the economic implications of European Community trade policies, particularly the use of export subsidies and of U.S. policy alternatives to increase exports and to counter the European Community's actions. U.S. initiatives to enhance U.S. exports at the expense of the European Community could escalate into a more serious confrontation and might ultimately be more costly to the United States than to the European Community.

o Production Resources

- Irrigation and Conservation Tillage. An ERS study of irrigation development indicated that the area irrigated from ground water increased 7.5 million acres (22 percent) between 1974 and 1980. Sharply higher energy prices pushed irrigation pumping costs from \$570 million in 1974 to \$1.9 billion in 1980. Favorable economic conditions could lead to pump irrigation of 3 to 4 million additional acres in the Great Plains by 2020, and also to significant irrigation increases in humid States. Studies of conservation tillage showed that minimum tillage and no-till strategies can reduce soil erosion 25 to 99 percent while reducing fuel and labor costs and increasing farm profits.
- Landownership and Farmland Values. An ERS survey of U.S. farmland values indicated a national average decline of 6 percent during the year ending April 1, 1983. That decline, coupled with a 3-percent rise in the Consumer Price Index, implies a 9-percent drop in the real value of farmland for the year. Foreign investment in U.S. agricultural land continued to increase moderately. Activities of real estate agents and monetary exchange rates may strongly influence the location and timing of foreign investment.

## o Rural America

- Rural Development Strategy, 1983. The analysis of rural areas in the annual report of the Department, required by the Rural Policy Act of 1980, was based on information supplied by ERS. Authors of the report, Better Country, used that information to document a decade of significant social and economic progress for rural America and to point out remaining problems. ERS staff drafted summary sections on population change, income and poverty, economic structure, and rural governments which were used by the Office of Rural Development Policy in preparing the report.
- Rural Population and Employment. ERS's ongoing program of demographic analysis indicates that the rural population growth of the seventies is continuing in most parts of the country. The rate of employment growth in nonmetro areas has remained fairly constant since the rapid spurt in the early seventies. The metro growth rate in employment increased considerably late in the decade but remains lower than in nonmetro areas.

## Statistical Reporting Service (SRS)

### Significant Activities

- o Computer-Assisted Telephone Interviewing (CATI) - Application tests of CATI for SRS telephone surveys continued in 1983 in California. This research was designed to apply the computer hardware and software, originally developed by the University of California at Berkeley, to improve SRS data collection procedures. Results are being compared with results from conventional telephone interviewing where responses are recorded on paper questionnaires. CATI improves the quality of data by detecting and resolving potential errors in reporting while the respondent is on the phone. Testing will be expanded to Nebraska in 1984.
- o Research to Develop Objective Yield Procedures - Research on rice, grain sorghum, and sunflower yield determination continued for the third year to develop an at-harvest yield estimating capability and also study appropriate relationships for forecasting early in the growing season. Operating program estimation procedures can now be recommended for rice and grain sorghum.
- o Development and Evaluation of Plant Growth Simulation Models - Extensive evaluation has been conducted on two wheat models with recommendations for both model improvement and evaluation of potential for Agency testing. The wheat models were developed in cooperation with the Agricultural Research Service and university scientists. Initial evaluations were conducted with a soybean model developed cooperatively with the University of Florida and a corn model developed with Agricultural Research Service scientists. Extensive work continued in developing and refining tools to evaluate functional relationships in simulation models. The research with process-level growth models

aims at improving early-season forecast methods in the SRS yield forecasting and estimation program to replace or supplement the present system of using relatively simple empirically based modeling techniques. As a part of the cooperative program with other institutions for both the corn and soybean models, the models include "feedback" to allow actual field measurements to be used for adjusting the models to the reality of growth.

- o Cooperative Research to Develop Remote Sensing Technology - Research on remote sensing applications for minor crop estimates continued in California in 1983. Cooperators include the California Departments of Agriculture and Water Resources, the University of California at Berkeley and the NASA/Ames Research Center. With minor modifications, remote sensing techniques developed for crops in the Midwest will be applicable to California.
- o Evaluating Portable Electronic Data Recording Instruments - Since SRS collects much data by field enumeration or observation, a research study was conducted to determine feasibility of using handheld, battery-operated, portable data entry devices under field conditions. The potential advantage is the ability to transmit data rapidly from the field directly to a computer environment, which eliminates the need for time delays in the mail and could improve the accuracy of data collected.

#### Accomplishments

- o LANDSAT 4 Crop Acreage Estimates - LANDSAT 4 data were used with SRS area survey data to calculate improved crop acreage estimates for Arkansas, Colorado, Kansas, Missouri, Oklahoma, Iowa, and Illinois in 1983. Significant improvements in methodology made in the last decade have reduced costs from \$300,000 in 1978 to about \$120,000 in 1983.
- o Improved Digitization Methods - Improved methods of recording field locations from aerial photographs were put in operation in 1983. In four states, digitizing tablets were connected to micro-computers, which greatly reduced phone line charges and central processing unit costs on a leased computer. In addition, ground data for three states were digitized through a video camera, an image processing system, and a micro-computer. Resulting high-throughput digitizing of ground data increases productivity, when compared to manual digitization on conventional digitizing tablets.
- o Weather Yield Barley Model Development - Part of yield modeling research is to test and evaluate a full range of modeling capabilities, one of which is establishing relationships between meteorological data and yield potential. A barley model tested favorably in North Dakota. If this procedure can be expanded, a relatively low cost capability could be developed for many crops.
- o USSR Grain Production Forecasting and Estimating Methods - For a second year, timely input was provided with objective forecast methods for use in forecasting foreign grain production.

Significant Activities

- o Research and Educational Responsibilities - The Agricultural Cooperative Service (ACS) represents the focal point of national activity on research and educational programs related to economic, legal, financial, social, organizational, and marketing problems of farmers cooperatives. Studies by ACS, alone or cooperatively with other institutions, provide information to assist farmers in the development and operation of economically viable, farmer self-help organizations.
- o Cooperative Statistics and Educational Materials - ACS is the focal point for national and State cooperative statistics and educational materials on cooperative principles and practices as self-help means to increase family farm income. The agency provides materials on many subjects from elementary to advanced levels. Analysts conduct training for directors and managers of newly organized farmer cooperatives. ACS distributes materials and holds programs in cooperation with educational organizations, such as national and State Extension Services, the American Institute of Cooperation, and State farmer cooperative councils and committees.

Accomplishments

- o Manufacturing Costs of Dairy Products at Cooperative Plants - Cost data for 14 plants manufacturing cheese, butter, and powder were summarized and average costs for each product presented. Average cost curves were estimated for each plant. The least-cost plant size was identified for plants of each product type. Plant capacity use and seasonal volume variation and their impact on manufacturing costs were delineated.
- o American Cooperative Exporters - A study identified cooperative exporters of grain, fruits, vegetables, dried beans, peas, and lentils. Descriptions include products exported, location and capacity of processing and distribution facilities, contact information, and services offered to buyers.
- o Marketing Patterns of Local Grain Handling Cooperatives - Key findings indicate local cooperatives (1) accounted for about 40 percent of off-farm grain sales; (2) sold an average of 2 million bushels of grain per association; (3) shipped 53 percent of grain sold by truck and 43 percent by rail; and (4) cited interest costs and transportation as their major problems.
- o Supply Sales Programs of Regional Farm Supply Cooperatives - Sales programs of regional supply cooperatives for seed, fertilizer, feed, and farm chemicals were examined. Analysis of types of sales, sales outlets, personnel, promotional techniques, pricing, and other elements provided an assessment of the strengths and weaknesses of programs providing direction for improved operations.

- o Cooperative Fertilizer Retail Outlets - A sample of Iowa farmers showed honest management, making deliveries on time, relative size, willingness to negotiate price, and marketing grain were the most important attributes affecting a farmer's decision to patronize an independent or cooperative dealer. Cooperative outlets were generally in a strong competitive position.
- o Statistics on Farmer Cooperatives - For 1982, total business volume for U.S. farmer cooperatives was \$69.2 billion, down 3.2 percent from 1981 (\$71.5 billion). Marketing volume fell 3.5 percent, and farm supply volume declined 4.1 percent. The value of other services rose 17.1 percent. Number of cooperatives declined 1.4 percent, to 6,125 in 1982. Memberships totaled 5.1 million, down 3.7 percent from 1981.
- o Third Financial Profile of the 100 Largest Farmer Cooperatives - In fiscal 1982, these cooperatives recorded total sales of \$53.6 billion, a 7.4 percent decrease from 1981. Assets declined less than 1 percent at \$17.1 billion. Net worth accounted for 30 percent of total assets in 1982. Seventy-four cooperatives recorded net margins of \$372.6 million while 18 posted losses of \$247.8 million.
- o Membership in and Use of Marketing and Farm Supply Cooperatives - Fifty-six percent of U.S. farmers use cooperatives. About half of all farmers use farm supply cooperatives and about a fourth use marketing cooperatives. Cooperatives seem best adapted to serving the marketing and farm supply needs of medium and large-scale farmers, particularly dairy and cash grain farmers. They serve the greatest proportion of farmers when there is considerable uniformity in products produced and farms are relatively large.
- o Development of Economic and Financial Performance Measures Specifically for Cooperatives - Cooperative members, directors, and managers lack an appropriate means of assessing how well their organization is performing relative to its objectives and to other cooperative and noncooperative competitors. This study will provide such measures.
- o Technical Assistance - In FY 1983, ACS was active in 57 projects involving newly emerging cooperatives or unorganized producer groups. Work in 33 projects was completed during the year, and starts made in 29 new projects.

#### Agricultural Marketing Service (AMS)

#### Significant Activities

- o Electronic Marketing - The agency continues its program of testing the feasibility of computer-assisted trading of agricultural commodities. New projects were initiated in Oklahoma and Virginia for grains and Florida for fruits and vegetables. These studies will determine the needs and benefits of electronic marketing as well as conceptualize trading systems and evaluate feasibility. Assistance was provided the livestock industry for modification of computer software and training of



buyers and sellers to use computers for selling slaughter hogs. The electronic marketing system for hogs, CHAMP, began commercial trading in September and has achieved average weekly sales of approximately 20,000 head.

- o Efficiency in Food Distribution - Analysts recently completed a study of the economies associated with consolidated delivery of vendor items to retail food stores. Cost savings of more than 40 cents per case could be achieved. Although the idea was objected to by some food distributors, several major food and beverage industries have requested assistance with implementation.

#### Accomplishments

- o Wholesale Market Facilities
  - The analysis of survey data relating to wholesale food distribution facilities for the 10 southern counties of New Jersey was completed. Several firms were identified as candidates for relocation in improved facilities, and a wholesale food distribution center was designed for these firms in Camden County. Investment and operating costs for the new facility were developed to show financial requirements and potential benefits.
  - Work on development of farmer's markets was completed for Charlotte, North Carolina, and Lynchburg, Virginia. Both cities have initiated plans for implementation. Technical assistance for improving or adding new facilities was provided for several locations including Montgomery, Alabama; Hanover County, Virginia; and the Pee Dee Region of North Carolina.
- o Vegetable Marketing Opportunities - A pilot project was conducted in cooperation with Virginia Tech, the Virginia Cooperative Extension Service, and the Virginia Department of Agriculture to identify commercial market opportunities for new farm enterprises for some south-central Virginia counties. Significant opportunity exists for marketing of broccoli produced in Virginia and adjoining states. High-quality broccoli produced this year was praised by food chains and proved profitable for farmers.
- o Fourteen Container Sizes Endorsed - The United Fresh Fruit and Vegetable Association endorsed 14 container sizes for fruits and vegetables in conjunction with project MUM (Modularization, Utilization, Metrication). After prior research identified problems using 5 modular-sized containers, researchers in OT and AMS determined that 9 additional container sizes could be used. United's Congress of Committees accepted this recommendation at its meeting in September 1983. AMS and OT are conducting further tests for additional commodities.

Significant Activities

- o Deregulation Monitor Project. An OT Planning Committee identified seven issues as a followup to OT's 1982 Deregulation Assessment Report. Information was collected on each issue including data from visits made to 48 elevator operators and grain industry specialists located in the Midwest and Northwest regions. In seven regional workshops, additional evidence was obtained on rail grain rates, rail contracts, rail abandonments, cancellation of switching agreements, joint rates and through routes, market dominance and other issues, for a 1984 assessment report to be submitted to Congress. In addition, OT is developing procedures to monitor provisions of the Staggers Act.
- o Cryogenic Refrigeration in Delivery Vehicles. Safeway Stores formally agreed to loan for testing a cryogenic refrigeration system they developed. Also, the Evans Trucking Company, Wendy's Foods, and the Liquid Carbonic Corporation agreed to participate in a study to compare mechanical and cryogenic refrigeration systems installed in multitemperature food delivery vehicles.
- o Rural Development Advisory Council. OT served in a resource capacity at a meeting of Secretary Block's National Advisory Council on Rural Development on August 24 and 25. Recommendations on rural transportation were developed by the Council. The recommendations, which focus on the rural road and bridge situation, will likely stimulate research and education in this rural transportation area.
- o Packaging for Shipment of Bees. Fiberboard tubes with wirescreen end caps were tested for shipping bees to Alaska and Canada. The containers held up well in transit. A prototype vacuum machine was built to automate the packaging of the bees in the fiberboard tubes.

Accomplishments

- o Standards (MUM) for Packaging. Four articles were cleared for publication detailing research in MUM (Modularization, Unitization, Metrication) containers. Industry is showing a strong interest in using MUM containers. Growers and shippers in California have petitioned the California Department of Agriculture for permission to use MUM containers. Safeway, Inc., has made arrangements to buy products packed in MUM containers and has sent letters to growers encouraging them to pack in MUM containers. Duda & Sons will test-pack produce this fall. Agriculture Canada has adopted the MUM containers and is test-packing in all provinces using OT designed containers.
- o Feed Grains Paper. Analysts studied the effect of decreases in feed grain production in State feed grains surplus/deficits and resulting implications for transportation. The paper, released through USDA News Center, appeared in the trade press.



- o Pennsylvania Road & Bridge Project. A report is available on a two-county pilot study initiated by OT in Pennsylvania which (1) fostered the formation of a State level Agricultural Transportation Task Force of transportation officials, agricultural officials, and rural leaders; (2) developed a process for incorporating rural input in the State's transportation planning and programming process; (3) identified the essential roadways providing access between the rural agricultural areas and the State's commercial network of roadways and identified key transportation obstructions to the movement of agricultural inputs and products; (4) provided the framework for conducting a Statewide transportation study that focuses on rural needs; and (5) provided resource material for the Federal Highway Administration to assist other State departments of transportation in Statewide transportation planning and programming.
- o Cryogenically Refrigerated Railcar. A prototype cryogenic railcar with underfloor storage tanks was completed and five test shipments were monitored. In addition, a refrigerated railcar was modified with an overhead carbon dioxide snow refrigeration system. Two test shipments with this system were completed. Both types of refrigeration systems performed adequately.
- o Bulletin on Grain Distribution. A USDA Information Bulletin entitled "The Physical Distribution System for Grain" was cleared for publication by the end of the fiscal year. The publication sets forth the basic operations and equipment involvement in movement of grain from the farm through the system to domestic and overseas processors.
- o Cattle Railcar. The scope of this project which is to reduce bovine respiratory disease induced by the effects of transportation now includes the use of a modified Wilson cattle-hauling highway trailer. (Food, water and space for rest are made available.) In January 1983, an Ortner modified railcar test was made from Newport, Tennessee, to Amarillo, Texas, in conjunction with Texas A&M and others. A later test in September, with some changes in the Ortner car plus the addition of the Wilson modified trailer riding piggyback on a railcar, proved encouraging.

#### Office of International Cooperation and Development (OICD)

#### Significant Activities--Research

- o Bilateral Collaborative Research - Two years ago OICD organized a program of collaborative research involving eminent U.S. and foreign agricultural research centers. Eleven presently active projects involve USDA/ARS laboratories, U.S. agricultural universities, and institutions in Brazil, Mexico, Peru, the Netherlands, West Germany, Australia, and New Zealand.
- o U.S.-Israel Binational Agricultural Research and Development Fund (BARD) - BARD was established in October 1977 by the United States and Israel as an independent body governed by a board of three American and three Israeli directors. BARD began operations in 1979 and has funded over 240 joint U.S.-Israeli research projects.

- o Special Foreign Currency (SFC) Research Program - As authorized by the Agricultural Trade, Development, and Assistance Act of 1954, as amended by (P.L. 480), USDA uses foreign currencies to support agricultural and forestry research on problems of mutual interest to the United States and participating foreign countries. Since the program began in 1958, USDA has negotiated over 1,800 projects in 32 nations. The SFC program has involved small, targeted research projects that have been commended by participating foreign governments for high levels of accomplishments and increased agricultural productivity.

During FY 1983 approximately 95 research proposals were approved for negotiation and subsequent funding from SFC or U.S.-Yugoslavia Joint Board resources. These proposals were in areas noted as the highest priority by U.S. agricultural research agencies--basic research, plant germplasm collections and evaluation, human nutrition, hardwood forestry management, and forestry plantations for energy utilization.

- o U.S.-Spain Program of Agricultural Research - The 1976 U.S.-Spain Treaty of Friendship and Cooperation authorized a program of agricultural research cooperation, which OICD managed. Funded by the State Department, this program ended in March 1983. A replacement agreement is pending. The new program will emphasize basic plant science, animal production and health, forestry, agricultural economics, and technical innovation.
- o University Linkages - OICD encourages the participation of U.S. colleges and universities in international research activities, as directed by Section 1458 of the Food and Agriculture Act. Since the program's inception in FY 1980, awards have been made to 11 U.S. universities and counterpart institutions in Brazil, Colombia, Mexico, Nigeria, and the People's Republic of China, with the aims of (1) initiating consultations in areas of mutual concern, and (2) developing proposals for joint research activities. The 10 original linkages are now nearing completion, and future activity will be concentrated in the Bilateral Collaborative Research Program.

### Research Accomplishments

- o Bilateral Collaborative Research - West German and University of Georgia scientists have devised hot processing systems for fresh pork products, which may reduce in-plant holding time, increase refrigerated shelf life, and reduce shrinkage and factory energy consumption. Rutgers University and ARS researchers' preliminary findings indicate that damping-off and other soil-borne fungal diseases of row crops might be suppressed as effectively as with chemicals, using resident micro-organisms isolated from Mexican agricultural systems little changed from Aztec and Mayan practices. Biological and chemical controls for the most serious honeybee disease found worldwide outside North America and Australia, are the goals of Cornell and Brazilian researchers studying the biology and ecology of the parasitic bee mite, Varroa jacobsoni.
- o U.S.-Israel BARD - University of California/Riverside and the Agricultural Research Organization (Israel) are studying a new plastic wrap which could triple the shelf life of fresh fruit and reduce

refrigeration costs. Reducing decay, weight loss and chilling injury, this wrap will keep lemons fresh for 9 months and grapefruit fresh for 6 months. USDA and Washington State University scientists are working with Israeli colleagues on a potentially safe, effective vaccine for bovine anaplasmosis, which could prevent \$100 million in U.S. losses annually to this malaria-like cattle disease.

- o Special Foreign Currency Research Program - Recent notable accomplishments include: (1) development of successful biocontrol of the cereal leaf beetle, stemming from projects in Yugoslavia and Poland; (2) confirmation by Yugoslav researchers of the viral cause of sheep pulmonary adenomatosis, facilitating U.S. development of serological tests and a vaccine; and (3) development of effective control methods for the corn cyst nematode in Egypt and research underway in India on monitoring methods for this pest.
- o University Linkages - Tuskegee Institute and the University of Ibadan, Nigeria, have begun research cooperation under a linkage agreement to examine the biochemical and immunological profiles of cattle breeds susceptible and tolerant to trypanosomiasis to obtain a better understanding of the resistance mechanisms. The influence of trypanocidal drugs on innate resistance and the corresponding benefits of such drugs will also be assessed.

#### Significant Activities and Accomplishments--Scientific and Technical Exchanges

The principal goal of OICD's exchange activities is to expand the role of science and technology in reducing international trade barriers and promoting U.S. interests through shared mutual competencies and comparative advantage. Some examples are:

- o Agricultural Marketing - China. A U.S. marketing exchange team studied Chinese agricultural policies and procedures to develop information on the long-term objectives of China's agricultural sector. The team reviewed procurement plans, storage facilities, processing capabilities, and marketing policies.
- o Animal Health Agreements to Help U.S. Livestock Exports to China. China and the United States signed preliminary veterinary and animal health agreements governing quarantine restrictions for cattle, swine, and poultry. A significant step in creating positive agricultural trade relations with the most populous country on earth, the agreements facilitate U.S. exports of breeding stock and reduces trade barriers.
- o Soybean Symposium in China. The second joint U.S.-China soybean symposium, held in Jilin Province, included U.S. scientific, university, and private agribusiness participants. Participants reviewed progress in soybean research and production and agreed to exchange several germplasm varieties. The Chinese have, for the first time, provided 10 varieties of rare wild germplasm, which may be used to develop new higher yielding U.S. soybean varieties with increased disease resistance.

- o Air-pollutant Injury to Crops - France. Increased use of coal for power generation has exposed major agronomic areas of the U.S. to higher levels of air pollution. Estimated annual economic losses from sulfur and nitrogen oxide damage to animal and plant life range from \$1.7 to \$9 billion. American and French scientists are studying selected crop species' reactions to the presence of sulfur dioxide and the differences in crops' resistance to environmental stress. This information is essential to the development of hardier species and successful breeding in pollution-prone areas.
- o Remote Sensing - France. World leaders in remote sensing, the French are providing U.S. scientists advanced satellite data which is superior to U.S. LANDSAT information. High-resolution French satellite sensors are expected to produce data four times more precise, for use in area frame sampling techniques used to estimate crop areas and land use. USDA scientists will also review the results of French research on plant growth and yield modeling, building on their pioneering work with remotely sensed data in estimating evapotranspiration, crop stress, and yields. U.S. duplication of this work would have cost about \$2.2 million.
- o Biocontrol of Grasshoppers - Australia. Grasshoppers have caused an average \$23 million damage in the Great Plains each year for the past quarter-century. Exchange of information with Australian experts will center on biological control with new techniques of isolating pathogens, developed in the past 2 years, and the collection of control agents identified in Australia.
- o Almond/Science Package - Italy. Italy has agreed to conclude the almond/science negotiations if the European Community (EC) almond duty (Common Export Tariff) is reduced from 5 to 2 percent, in exchange for U.S. trade concessions and a science and technology program carried out over 3 to 5 years. Secretary Block and Italian Minister of Agriculture Pandolfi have signed letters of intent outlining each side's obligations. These obligations depend on EC action to reduce the duty on almonds to 2 percent and on Congressional approval and funding for the science and technology package. Reductions of the import duty will enhance marketing of U.S. almonds in Europe and will maintain a competitive annual export market of \$200-250 million for the U.S. almond industry. EC consumption of U.S. almonds could increase \$15 million per year due to lower prices.

### Forest Service (FS)

#### Significant Activities

- o Research Report Published - A report, "Our Natural Resources: Basic Research Needs in Forestry and Renewable Natural Resources," was prepared by a national taskforce of 17 scientists representing the spectrum of U.S. forestry research. The scientists identified needs for basic knowledge to assure that future research can provide to management the guidelines needed during the last years of this century, and beyond.

- o Genetic Engineering Research - Forest Service started a genetic engineering research program in FY 1983 with research studies in two areas: (1) nonsexual methods for tree breeding, and (2) individual heritable traits and recombinant DNA methodologies for transfer of genes in forest tree species.
- o Acid Rain Research - FS is emphasizing research on long-term impact of acid deposits on forest growth and vigor, and water quality. The agency has now participated for 2 years in the National Acid Precipitation Assessment Program.
- o Cost Control Activities - In FY 1983, FS, to streamline further its research organization, ended work of over 20 research work units and closed 6 locations. Research support services have been merged with National Forest offices in several locations. FS began a study to evaluate alternatives and develop a consistent process for expanding cooperative research relationships and active research participation with private industry, associations, and other interested parties.
- o International Trade Research - FS expanded economics research on opportunities for increased foreign trade in U.S. timber and wood-based products. This research, closely coordinated with the programs of USDA's Foreign Agricultural Service, will focus on trends in overseas shipments of timber and wood products, impediments to expanded exports of U.S. wood products, and the prospects for growth in this trade in the decade ahead.

#### Accomplishments

- o Fire and Atmospheric Sciences Research
  - North Central Station fire scientists, in cooperation with the State of Wisconsin and Michigan State University, have developed a system for evaluating the impacts of fire on forest resources in the Northeast. Negative and positive impacts of fire on timber, wildlife, recreation, ornamental trees, crops, equipment, and improvements are included.
  - A computer system that shows the probable location of lightning fires has been developed by fire researchers working at the Northern Forest Fire Laboratory. The system sorts data from thousands of lightning strikes and the condition of forest fuels, and displays in map form where fires are most likely to start. Forest Service and the Bureau of Land Management are testing the system.
- o Forest Insect and Disease Research
  - Biological control of European pine sawfly progressed in 1983, when the Environmental Protection Agency registered Neocheck-S, a naturally occurring virus disease. Introducing this safe virus results in a natural spread of the disease throughout sawfly populations and eliminates the need for chemical pesticides. Neocheck-S was developed at the Forest Service's Center for Biological Control in cooperation with university researchers.

- Research on beetle and decay problems in log-kit homes has led to a series of guidelines for preventing such damage. The guidelines include choosing building designs that do not trap moisture, debarking logs right after harvest, dipping logs twice in preservatives, and applying insecticide and water repellent liquids to finished homes.
- o Renewable Resources Evaluation Research
  - Unless timber, range, and recreation resources are managed more aggressively, the Nation will face a growing imbalance between the supply of these products and public demand. Forest Service reviewed the renewable resource situation and found the Nation could double timber production and triple forage output through intensive management.
  - Analysis of hardwood stands in the Piedmont reveals that these areas can be managed inexpensively for greater timber production. Nonindustrial private landowners can use this analysis to minimize their out-of-pocket treatment costs, increase incomes from timber harvesting, and upgrade future stand conditions.
- o Renewable Resources Economics Research
  - A new model developed in the Southeast simplifies calculation of the profitability of many forestry investments. This model, which can be run on several inexpensive microcomputers, answers questions such as: does fertilization pay, are pest management activities cost effective, and are timber stand improvements good investments? Public and private foresters are using the program to select the best management options on forest lands.
  - In Oregon, scientists have found that the economic impacts of increasing the supply of local Forest Service timber far surpass the economic benefits of importing logs. A supply impact model developed at the Pacific Northwest Station will help forest economists assess the significance of changes in capital flow and resources needed to produce goods and services in any forest-dependent area.
- o Surface Environment and Mining
  - Miners, environmentalists, and State regulatory agencies are using a new analysis of the acidity of streams throughout the coal-mining region of Appalachia. Forest Service scientists have also developed automated methods to analyze the alkalinity of natural waters at low concentrations.
  - Revegetating bentonite mine spoils is difficult because of low pH, soil salinity, high sodium and sulfur concentrations, and soil compaction. Reclamation efforts, including contouring, topsoil spreading, and seeding, show some promise of overcoming undesirable soil chemistry.



o Trees and Timber Management Research

- The cost of controlling kudzu--an imported vine pest--is down from \$150/acre to as little as \$75/acre due to herbicide techniques developed at the Southern and Southeastern Forest Experiment Stations. Researchers have screened over 25 herbicides to find a cheap, effective formulation and a ground application system suitable for nonindustrial forest landowners.
- Experiments on the Wenatchee National Forest in Washington revealed that Douglas-fir and ponderosa pines can make startling gains in growth if particular herbicides are applied at planting time to suppress nearby vegetation. One treatment led to a 650-percent increase in Douglas-fir stem volume at the end of 6 years, compared with nearby trees in untreated plots.

o Watershed Management Research

- Structure of subsurface rocks affects the stability of roads, so the Forest Service devised techniques to test rock strength and below-ground water content on slopes. These research findings will yield substantial savings in road repair costs, particularly where we have no preconstruction data on subsurface conditions.
- Scientists in the Rocky Mountain area discovered that harvesting trees in small circular patches over about a third of a watershed will trap blowing snow and increase local water yields without causing spring floods.

o Wildlife, Range, and Fish Habitat Research

- The literature on sagebrush-grass vegetation management covers over 1,250 separate articles. A summary incorporating the most important information from these articles is the first in a series on management of intermountain rangelands prepared by the FS.
- The FS Intermountain Station has joined with the USDA-Soil Conservation Service and Utah's Division of Wildlife Resources in releasing for propagation three range plants for use on arid sites. These plants are especially useful for stabilizing disturbed soils and providing forage.

o Forest Recreation Research

- Fear of crime in urban parks and forests prevents many citizens from using these resources. Forest Service scientists have discovered what makes people feel safe--buildings, cars, and many other people nearby, as long as the park and nearby structures are well-maintained and free of graffiti.
- Several agencies manage over 80 million acres of National Wilderness. Most managers share the problems of resource degradation and loss of solitude. Data in a recent survey are helping managers identify

alternative responses to problems and areas with similar difficulties.

o Forest Products Utilization Research

- Scientists at the Forest Products Laboratory have identified for the first time an enzyme active in breaking down lignin, the natural plastic that makes up 25 percent of wood. This discovery, along with increased understanding of the wood decay process, may lead to biological methods for controlling decay.
- Cooperative research at the Forest Products Laboratory and several universities has led to structural analysis methods to predict stiffness and strength of light-frame floor and wall components in housing. Both suppliers and users can predict how changes in materials or construction will affect serviceability and safety of these floor and wall systems.

o Forest Engineering Research

- Forest Service engineers have developed a new machine that slices small-diameter trees, logging residues, and unsaleable material into chunks much larger than conventional whole-tree chips. The chunkwood has characteristics superior to wood chips for use as wood fuel or for the production of structural flakeboard and other composite wood products.
- Surface erosion from forest roads is the primary source of long-term sediment production. FS engineering researchers have developed techniques to predict the surface erosion expected for given soils, geologic conditions, vegetation, road specifications, and climatic events.

o International Forestry

- The Forestry Support Program (FSP), a joint Forest Service/Agency for International Development (AID) effort, was extended through 1988. It continues to identify available sources of forestry expertise for AID projects involved in forestry development in many nations. FSP personnel are involved in AID projects review and in consultation in the field.
- New efforts between the United States and Brazil, as well as the United States and Mexico, involve mutually beneficial interchange on forestry matters. Other bilateral agreements involving the United States with China, Greece, Portugal, India, and Canada have also been active during 1983.

o Forest Biomass Energy Program

- A survey of FS research projects showed that 26 percent of studies underway will provide biomass inventory, production, and harvest information that will contribute to the development and use of wood for energy purposes.



- The Forest Service participated with the Department of Energy in the establishment of four Regional Biomass Energy Programs. These programs with a focus on forest biomass, will require continued support and participation by FS as they develop.

#### Cooperative Extension Service (CES)

##### Significant Activities

- o Residue Avoidance Program. Extension Service-USDA and USDA's Food Safety and Inspection Service (FSIS) successfully launched a continuing cooperative effort to help livestock and poultry producers avoid violative drug and chemical residues in their slaughtered animals by educating farmers on proper animal drug use. Thirty-one State Cooperative Extension Services are involved in 37 projects, which include publications, residue hotlines, animal medication surveys of pesticide practices, exhibits, and slide sets.
- o Integrated Livestock Production Systems. In response to a mandate from the livestock industry, Extension programs nationwide are integrating component research results into systems which increase overall productivity. Supporting this approach are the Integrated Reproduction Management, Residue Avoidance, and Grazing Lands and People programs. Current financial conditions require that producers know which of these multifunctional components can be implemented economically and in what combination. Unless a systematic approach is followed, adoption of a particular component may lead to economic losses rather than gains. The PEGRAM program in Idaho demonstrates how the systems approach can lead to net benefits for producers. After initiation on three cooperating ranches, the Idaho Cattlemen's Association worked with Extension to expand the program with estimated net gains of \$3 million accrued to 20 additional participating ranches.
- o Integrated Pest Management. The Extension Integrated Pest Management (IPM) program is a major source of information for the National Pest Survey conducted by USDA's Animal and Plant Health Inspection Service (APHIS). Pest specialists in a variety of disciplines and organizations (public and private) can use the information on pest occurrence and abundance. Cooperation among Extension Service-USDA, APHIS, State Cooperative Extension Services, State Departments of Agriculture, and private IPM organizations provides a useful decisionmaking tool for pest management operations nationwide.
- o Renewable Resources Extension Act (RREA). The funding of the Renewable Resources Extension Act, with \$2 million in 1982 and 1983, serves as a catalyst for Extension programming for private nonindustrial forest and rangeland owners and managers. These programs are resulting in expanded efforts nationwide in training sessions, correspondence courses, seminars, demonstrations, and continuing education to assist owners and managers to reach their objectives, whether for timber, forage, wildlife, or recreation.

- o Reforestation and Timber Stand Improvement. Projections for timber supply and demand indicate that demand for softwood and hardwood will exceed supplies through the year 2030 and beyond. In cooperation with other Federal agencies, the timber industry, and States, Extension Service-USDA is increasing State and local programming in reforestation and timber stand improvements. In the South and Northeast regions of the country, county productivity committees work with landowners to conduct reforestation and timber stand improvement efforts with Extension and industry.
- o Electronic Technology. Electronic technology applications to support and improve program management, interactive communications, and program delivery to clientele continue to accelerate as Extension moves forward in the electronic age. A nationwide Extension electronic mail network now serves all 50 States, the District of Columbia, and Guam. In Missouri and Colorado, district and some county offices are also on the system. Two databases--the Computer Outlook Information Network (COIN), and the National Accomplishments Reporting System (NARS)--operate nationally over the electronic mail system. Electronic mail is under evaluation to determine effectiveness and efficiency and to make future recommendations for optimum use. Statewide computer systems such as FACTS (Indiana), EXTEND (Wisconsin), and ESTEL (Maryland) expedite communications and program delivery throughout the Extension system. As agriculture knowledge suppliers, Extension is translating research into software for family farms, agribusinesses, marketing institutions, families, and communities. A joint ECOP (Extension Committee on Organization and Policy) and Extension Service-USDA Committee on Electronic Technology will assess the current status of the technology, plan for future application, investigate interfacing, and identify policy issues.
- o Expanded Food and Nutrition Education Program (EFNEP). After a congressionally mandated needs assessment of the purposes and objectives of this unique Extension program for low-income families, Extension Service-USDA developed recommendations to improve the content, delivery, accountability, and evaluation of the program. Ten EFNEP Food Stamp projects funded with \$1 million from Extension Service-USDA and \$1 million from USDA's Food and Nutrition Service will be completed in 1983. The State projects are: (1) testing alternative teaching methods for reaching more families with nutrition information, and (2) evaluating these methods. Extension Service-USDA conducted orientation training for participating States. The agency also conducted a national EFNEP orientation workshop for the new recipients of program dollars--American Samoa, Micronesia, Guam, and the Virgin Islands.
- o Food Economics. While traditionally providing food economics information to consumers, Extension has increased efforts to meet needs of the unemployed and financially restricted families. Extension programs across the country include best food buys information; point-of-purchase consultations; meal planning; budgeting help; preparation suggestions; methods of preservation; and complete menus for using food stamps or restricted resources to their maximum. The nationwide Extension Master Shopper program trains volunteers with extended training to reach more people with food economics information

at supermarkets, farmers markets, and surplus food distribution centers. Extension Service has also prepared special materials to be given with the food at surplus distribution centers on how to best use, prepare, and store these products for optimum nutrition and appeal. Best food buys information, no longer available from USDA's Agricultural Marketing Service, is now available nationally on the electronic mail network from Wisconsin.

- o 4-H Citizenship. The Extension Service-USDA provides leadership to a national teen citizenship program involving more than 10,000 4-H'ers (aged 14-18 years) each spring and summer. Using the Nation's Capital as a classroom, youth from across the country discuss problems and possible solutions with Senators, Representatives, and officials of public and private organizations during a week-long course. USDA officials brief each group on agricultural issues and legislation. Each participant returns home with a plan of action for implementation in his or her community.
- o Local Government. Through a new computer information service called LOGIN (Local Government Information Network), Extension Service-USDA provides States access to an information database on a wide range of needs and problems, including issues in local government, economic development, and community services and facilities. The database provides case-study analyses based on local community experiences and innovations from across the country. Extension Service-USDA also provides leadership for the Federal Laboratory Consortium (FLC), a coalition of 300 Federal labs and agencies that conduct high-technology research in domestic areas that include transportation, energy, housing, public works, and business productivity. The Technology Innovation Act of 1980 mandates that the FLC provide technological knowledge and technical assistance to local and State governments and the business community. In its leadership role, Extension Service-USDA coordinates the technology transfer programs of these member labs.

## Accomplishments

- o Integrated Reproductive Management. Extension Service-USDA continues to emphasize program leadership and coordination on integrated reproductive management (IRM). From its inception, IRM has been a coordinated effort of the four S&E agencies (ARS, CSRS, NAL, and ES). This cooperation and coordination exist at Federal, regional, and State levels, where multifunctional and multidisciplinary projects in IRM are underway.
- o Farm Financial Management. Extension programs in farm financial management assist producers in preparing and analyzing cash flow and other financial statements, developing improved farm organizational plans, and making effective marketing decisions. Farmers receive assistance in coping with difficult financial problems through intensive Extension workshops and use of computerized financial management tools. Specific examples are the "Troubleshooting the Farm Business" program in Missouri; and the 450 Ohio financial management program events attended by more than 28,000 farmers and agribusiness representatives. The "Farm Financial Management" handbook prepared in South Carolina typifies similar efforts in nearly all States. Fact sheets have been developed

including those on "Farm Financial Management," "Producer Grain Marketing," and "Producer Marketing Alternatives for PK Commoditys."

- o Direct and Electronic Marketing. Extension continues to provide educational assistance to farmers involved in direct and electronic marketing--especially small farmers. Direct marketing projects, developed through the funding of the Farmer-to-Consumer Direct Marketing Act of 1977, are continuing and, in some States, expanding. Major emphasis is on pick-your-own and roadside marketing. Such expansion includes programs in direct marketing of livestock products. Electronic marketing has a major impact on prices paid to farmers by increasing competition and improving marketing efficiency as buyers and sellers negotiate via computer terminals. An educational program contracted with Virginia Polytechnic Institute and State University included four regional workshops for the agricultural industry, a proceedings, general brochure, and a slide-tape set developed for additional educational efforts.
- o Federal Crop Insurance. Using Federal Crop Insurance Corporation (FCIC) funds, Extension Service-USDA developed microcomputer software programs in cooperation with Texas A&M University to assist farmers with their decisions on crop insurance. Extension and FCIC held four regional workshops to train Extension specialists in use of these computer programs. The workshops enabled State specialists to train county staff who assisted farmers in making decisions on crop insurance needs for 1983. In addition, Extension conducted an expanded educational program to assist farmers in understanding the use of crop insurance as a risk management tool.
- o Soil and Water Conservation. Extension programs in soil and water conservation reflect the priorities of the National Conservation Program. These programs vary widely in content and focus, as Extension responds to State and regional interpretation of the problems of soil erosion, water conservation, and associated priorities. In the Northwest, programs focus on the use of conservation tillage to reduce soil erosion on the wheatlands of the Palouse and the Columbia Plateau; in the Southwest, the focus is on irrigation management, pumping plant efficiency, and use of waste waters and other nonconventional sources of water for irrigation. In the South, Extension programs emphasize conservation tillage to reduce erosion, conserve moisture, and improve productivity; and water conservation is receiving attention to stretch existing supplies for both agriculture and domestic uses. The North Central States have expanding programs of conservation tillage, irrigation management, and ground water protection. The Northeast is experiencing a resurgence of efforts to protect the quality of surface waters (for example, the Chesapeake Bay) and groundwater from the impacts of urban and rural activities. The linkage between the water resources (surface waters and groundwaters) and the management of the land resources (for agriculture and development) are emerging as major issues in many Extension programs.
- o Family Financial Management. Financial planning and management for families continues as a major program emphasis for Extension nationwide. In cooperation with Indiana, Extension Service-USDA developed and

distributed nationally a "Curriculum Sourcebook for Financial Planning and Management for Families" which documents the content of what Cooperative Extension teaches in this area, and identifies selected educational resources that support this content including public and private sector databases. Extension Service-USDA also funded and distributed nationwide results from several special projects, including one in Mississippi where financial planning centers are established throughout the State.

- o 4-H/Youth Natural Resource Projects. More than 846,000 young people across America participated in Extension 4-H natural resources programs and related activities with special emphasis in forestry (131,700 participants) and wildlife and fisheries (244,000 participants). Extension Service-USDA membership on the National Wildlife Advisory Board provides for interagency liaison on fish and wildlife policy. Extension Service-USDA also cooperated with USDA's Forest Service in developing a new educational unit "Economically Important Forest Insects and Diseases" for use in 4-H forestry projects nationwide. Other 4-H forestry projects include a two-county special project in West Virginia on forestry careers involving 80,000 youth, including 2,000 4-H'ers.
- o National Rural Development Symposium. Working with seven USDA agencies and the Rural Government Coalition, Extension Service-USDA developed and supervised the organization of the National Rural Development Symposium. This is a first effort in the national rural development policy process mandated by the 1980 National Rural Development Policy Act. The Coalition consists of the national associations of towns and townships, counties, development organizations, and regional councils, in cooperation with the National Governors Association. The project offers USDA agencies an opportunity to interact with members of the Coalition on substantive issues facing rural governments. The new Symposium identified program training for issue-management skills by local officials as a major need. To meet this need, the USDA Rural Development Committee funded a project for four multistate conferences and four national policy forums with funding from 16 USDA agencies to the Rural Governments Coalition. Extension Service-USDA collected the funds, executed cooperative agreements with the four principal members of the Coalition, and involved other Federal agencies, including the Department of Transportation and the Department of Housing and Urban Development, in the project.

#### National Agricultural Library (NAL)

#### Significant Activities

- o Regional Document Delivery. A new region in the USDA-NAL Regional Document Delivery System began operation in July. The region covers Michigan, Ohio, Pennsylvania, and New York. Seven regional centers linking 35 land-grant university libraries with NAL are now operating nationwide. More than 67,000 documents and photocopies of articles were provided to USDA personnel and libraries through the centers in FY 1983. Primary users of the system continue to be personnel of the Agricultural Research Service and the Forest Service, followed by Soil Conservation Service.

- o State Microfilming Projects. Purdue, University of Missouri, and Iowa State University participated in this year's efforts for filming of their agricultural publications in cooperation with NAL. Since NAL launched this cooperative program in 1974, the documents of 36 States totaling over 2 million pages have been microfilmed for archival, preservation, and storage purposes. Bulletins, circulars, reports and other land-grant documents are filmed upon recommendation of a users and librarians advisory group.
- o Full Text Transmission. Development of a pilot database for electronic transmission of the complete text of selected books, articles, pamphlets, flyers, and other documents will be conducted in consultation with Extension Service-USDA, the Agricultural Research Service, and other Federal and State units. The purpose is to enable NAL to produce and disseminate a full text database, using state-of-the-art retrieval technology before the end of 1984. The result could be direct electronic access to agricultural information by technical information specialists, scientists, farmers, and the general public.
- o Cooperative Indexing. Arrangements were made by the National Agricultural Library, in cooperation with a land-grant university, for the indexing of specified agricultural journals and/or subject materials. Indexing will be done only once by the contracting institution, conforming to standard formats established by NAL. These records will be treated as if they were done within the National Agricultural Library and will constitute the national record.
- o Collection Development. NAL has registered its interest with the Research Libraries Group of the Association of College and Research Libraries in synopses being developed on the holdings, collecting level, and collection responsibilities of major U.S. research libraries. In consultation with the Research Libraries Group, NAL has agreed to complete the synopses for subjects dealing with agriculture on which its own collections are based. NAL has indicated its interest in being the prime coordinator among the land-grant institutions for collection development in agricultural fields.
- o CONSER Project. A request was forwarded to the Library of Congress to reactivate NAL participation in the CONSER Project and to allow it to assume national responsibility for the coordination and quality control of information on current agricultural journals, periodicals, and serials input into this project. NAL has also requested that the Library of Congress designate to NAL national responsibility for maintaining name authority records for current agricultural serial publications.
- o Foreign Exchange. Some 150,000 books and periodicals of foreign origin were added to the Library's collection this year under agreements with 6,000 overseas exchange partners (foreign governments, and educational and research institutions). A newly streamlined exchange program will send an equal number of USDA publications overseas in return for foreign materials which constitute about 60 percent of the total NAL collection of 1.8 million volumes.



Science by nature is future oriented, involving long time frames over which research and education take place. In food and agriculture the effect of science is also widespread with impacts on not only the entire population of the United States, but also hundreds of millions in other nations.

Thus, many entities, organizations, and individuals have made and continue to make recommendations on food and agricultural science priorities and directions for the future. Included in this section of the report are recommendations and reactions from the Department of Agriculture, the Joint Council on Food and Agricultural Sciences, the Agricultural Research and Extension Users Advisory Board, and State and Federal research and extension administrators.

#### Departmental Objectives

Several of the top 16 USDA objectives for the future, as determined at the Secretary's Top Staff Conference in July 1982, are directly related to the food and agricultural sciences. These include:

- o Provide Leadership in Helping Farmers Market Their Products. Research and education agencies will improve the knowledge and information bases available to agricultural producers concerning presently available marketing alternatives; identify opportunities for developing new marketing alternatives; provide information, training, and technical assistance to producers which will improve their marketing skills, practices, and strategies.
- o Develop New Agricultural and Forest Crops and Products. Develop a research program that will provide the technology needed to produce new agricultural and forestry crops to meet national needs; provide for crops for arid lands, problem soils, strip-mined areas, and family farms; and develop new crops that will supply new medicinals, gums, waxes, resins, oils, proteins, hydrocarbons and fibers for industrial use and new crops to replace crops in chronic surplus.
- o Increase Efficiency in Food, Fiber, and Forest Products Processing, Marketing, and Distribution. Conduct fundamental research on the physical and biological aspects of agricultural and forest products and the processes by which they can be preserved, converted into safe and useful products, and transported from producer to consumer; conduct economic research on costs and efficiency in the marketing system, and the economic performance of markets for agricultural and forest products; and provide for the extension of technology and market intelligence to producers, marketers, and consumers.

#### Advisory Board Recommendations

The Joint Council (JC) on Food and Agricultural Sciences and the National Agricultural Research and Extension Users Advisory Board (UAB) have prepared recommendations that build upon the significant contributions of the agricultural science and education system. The recommended adjustments are viewed as necessary in maintaining the preeminence of this national agricultural system.

The program priorities recommended by both advisory boards reflect a national concern with meeting food and fiber requirements of the 21st century. The increased emphasis now placed upon fundamental science must continue to build to further undergird the unfolding biotechnological revolution. At the same time, our natural resource base must be conserved as the basis for sustaining improvements in production and marketing efficiency. Increasing agricultural exports are recognized as essential to a healthy agricultural economy.

The JC and UAB reports contain a number of specific recommendations outlined in the following sections.

#### Joint Council Recommendations

The national priorities recommended by the Joint Council reflect the different driving forces at local, State, and Federal levels that embody national concerns. The JC in 1983 formulated eight national priorities for FY 1985 as follows:

- o Basic Biotechnology Research. Biotechnologies in the form of improved plants and animals are historically associated with agriculture. Recent developments in genetic and cellular biology promise many future technologies for improving productivity and protection.
- o Scientific Expertise Development. Declining college enrollments in agriculture will lead to a shortage of scientists, technicians, and entrepreneurs needed to develop and implement new opportunities in agriculture technology, and they will eventually result in a decline in productivity.
- o Communications Technology. The technology for gathering, analyzing, and disseminating information is advancing rapidly. Modern computer technology and telecommunications offer great potential for increasing agricultural productivity by improving efficiency of information exchange between and among scientists, extension specialists, producers, and consumers.
- o Analysis of Price and Income Policies with Emphasis on Foreign Trade. Periodic excess supplies of agricultural and forestry products have created uncertain economic markets over the past 50 years and are expected to continue to do so in the future. Improved estimates and projections of worldwide crop, livestock, and timber supply and utilization need to be developed and disseminated to decisionmakers.
- o Sustaining Soil Productivity. Accelerated soil erosion represents a cost to the landowner and society. Extension needs to encourage adoption of such farming practices as conservation tillage.
- o Human Nutrition, Including Food Safety and Quality. More information is needed on nutritional quality of foods, effects of processing, and the relationship between dietary habits and chronic diseases.
- o Water Management. In the future, the acreage of water-stressed crops will increase because of competition from other water users, declining ground water tables in many areas, and increased use of droughty or



poorly drained soils. Therefore, agriculture must improve its water use efficiency just to maintain present production levels from irrigated farms.

- o Productivity Enhancement of Forest, Range, and Pastureland, Including Multiple Use. Forest, range, and pasturelands are the dominant land use categories in the United States. These resources must be managed and used wisely if Americans are to obtain the full complement of values. Some critical issues are low productivity levels, especially on small forest holdings; effects of acid rain; old growth/wildlife habitat conflicts; range rehabilitation; and pastureland ecology.

The Joint Council has also overseen the preparation of comprehensive reports on long-term needs for food, fiber, and forest products and plans which would allow the research, extension, and education community to meet these needs. These reports were forwarded to Congress in early 1984 under the following titles:

- o Needs Assessment for Food and Agricultural Sciences.
- o Five-Year Plan for Food and Agricultural Sciences.

#### Users Advisory Board Recommendations

The 10th report of the National Agricultural Research and Extension Users Advisory Board (UAB) July 1983 states "the following biotechnical research areas are program priorities which hold promise for significant scientific research in agriculture:"

- o Genome structure and gene expression.
- o Resistance mechanisms of plants and trees to pests and diseases.
- o Crop germplasm conservation.
- o Plant biological stress.
- o Rhizosphere research.
- o Animal disease resistance.
- o Animal biological stress.

Increasing support for agricultural research through competitive funds granted by non-USDA agencies such as the National Science Foundation (NSF) and Department of Energy (DOE) has shifted capacity to conduct frontier research from the Agricultural Research Service (ARS) and State Agricultural Experiment Station (SAES) system to a handful of SAES and private universities with the scientific expertise, equipment, and instrumentation necessary to stimulate scientific discovery. Scientific breakthroughs in these facilities are shared on a scientist-to-scientist basis with private agribusiness scientific staffs for commercial application.

## Availability of Reports

Copies of Joint Council and Users Advisory Board Reports can be obtained from:

Executive Secretary  
Users Advisory Board  
Room 319A  
U.S. Department of Agriculture  
Washington, D. C. 20250

or

Executive Secretary  
Joint Council on Food  
and Agricultural Sciences  
Room 321A  
U.S. Department of Agriculture  
Washington, D. C. 20250

### Research Administrators' Projected Change in Research Emphasis, 1983-88

During 1983, the Joint Council asked Research Administrators in the Federal/State Agricultural Research System (USDA Research Agencies, ARS, ERS, FS, ASCS, AMS, and OT and State Agricultural Experiment Stations, Schools of Forestry, 1890 Land-Grant Colleges, Tuskegee Institute, and Schools of Veterinary Medicine) to identify changes they would make in the distribution of research resources by 1988 if they (1) had no change in total resources, or (2) received a 20 percent increase in total scientists years (SYs) available for research over the 5-year period.

There would be only slight changes from 1983 to 1988 in Scientist Years by Research Program Groups (RPG) if no new resources were available (fig. 2). Under these conditions, work in RPG 1, Natural Resources, and RPG 6, 7, and 8 would increase slightly and RPG 2, 3, 4, and 5 would decrease a bit. There would be small shifts (under static conditions) in SY's from work on crops, animals, forest resources, and people community/environment, to work in the other research program groups.

If a 20-percent increase in resources were available by 1988, more effort would be channeled into all RPGs; crops, animals, forest resources, and natural resources would receive the greatest increase in number of scientists years (fig. 2).

Within the RPGs however, a markedly different pattern is apparent. For example, in RPG 3 (crops) assuming no overall increase during 1983-88, research on wheat, rice, soybeans, peanuts, forest range and pasture, and fruit and vegetable crops would receive additional SYs of effort. Research efforts on grain sorghum, small grains, sugar, cotton, tobacco, new crops/oil seeds, plants enhancing the environment, and bees and other pollinating insects are projected to decrease by 1988 (fig. 3).

Similar patterns can be observed within the Natural Resources, Forest Resources, Animals, and Food Science RPGs. In RPG 5, People, Communities, and Environment, on the other hand, scientist years devoted to all research programs within the RPG would likely be reduced if no increase in resources occurs. (Appendix).

All Research Programs (RPs) within RPG 6, Competition, Trade, Adjustments, Price, and Income, and RPG 7, General Resources, would likely increase, even if no overall increase in resources was available for 1983-88.

In summary, the Research Programs (RPs) likely to receive increases in scientist years, assuming no increase in overall resources by 1988 are as follows:

RP		SY
1.01	Soil and Land Use	21.6
1.02	Water/Watershed	19.5
6.03	Marketing Competition	11.0
3.14	Vegetable Crops	9.7
6.01	Farm Adjustments, Price, and Income	9.5
7.02	Technology, Nonclassified	9.0
6.02	Foreign Agricultural Trade	8.6
4.01	Beef	7.4
3.09	Forest, Range, and Pasture	5.8
8.01	Human Nutrition	5.4
4.03	Swine	4.4
3.07	Peanuts	3.5
2.04	Forest Harvesting, etc.	3.4
3.06	Soybeans	3.1
3.03	Wheat	2.8
2.01	Inventory and Appraisal of Forest Resources	1.9
3.05	Rice	1.9
3.13	Fruit	1.2
7.01	Manmade Resource	1.2
2.09	Technical Assistance (Forestry/Wood)	1.1
4.07	Aquatic Foods	.9
8.02	Food Processing	.9
2.06	Forest, Range, and Wildlife	.8
8.04	Food Storage, Distribution, and Marketing	.7
1.06	Fish and Wildlife	.7
2.05	Forest Watersheds, etc.	.7
1.07	Remote Sensing	.6
4.01	Poultry	.2
2.10	Trees, Forest General	.2
2.11	Forest and Range Resources	.2
3.07	Weeds in Crops	.2

With no increase in scientists years available, administrators of research in the USDA Land-Grants System anticipate shifting additional resources into some of the high-priority areas identified by the Joint Council on Food and Agricultural Sciences, the Department of Agriculture, and Agricultural Research and Extension Users Advisory Board. The relation between priority recommendations and projected shifts in actual scientific man-years of research devoted to various research programs, correlates more closely in the current 5-year projections, 1983-88, than for previous projections made 2 years ago for FY 1981-86. In general, with a 20-percent increase in overall resources over the 5-year period, all Research Programs in all Research Program Groups would receive additional resources but at varying levels. Details of the projections by RPG and RP are given in the appendix under both sets of assumptions.

Figure 2

# 1983 SCIENTIST YEARS AND PROJECTED 1988 SCIENTIST YEARS BY RPG

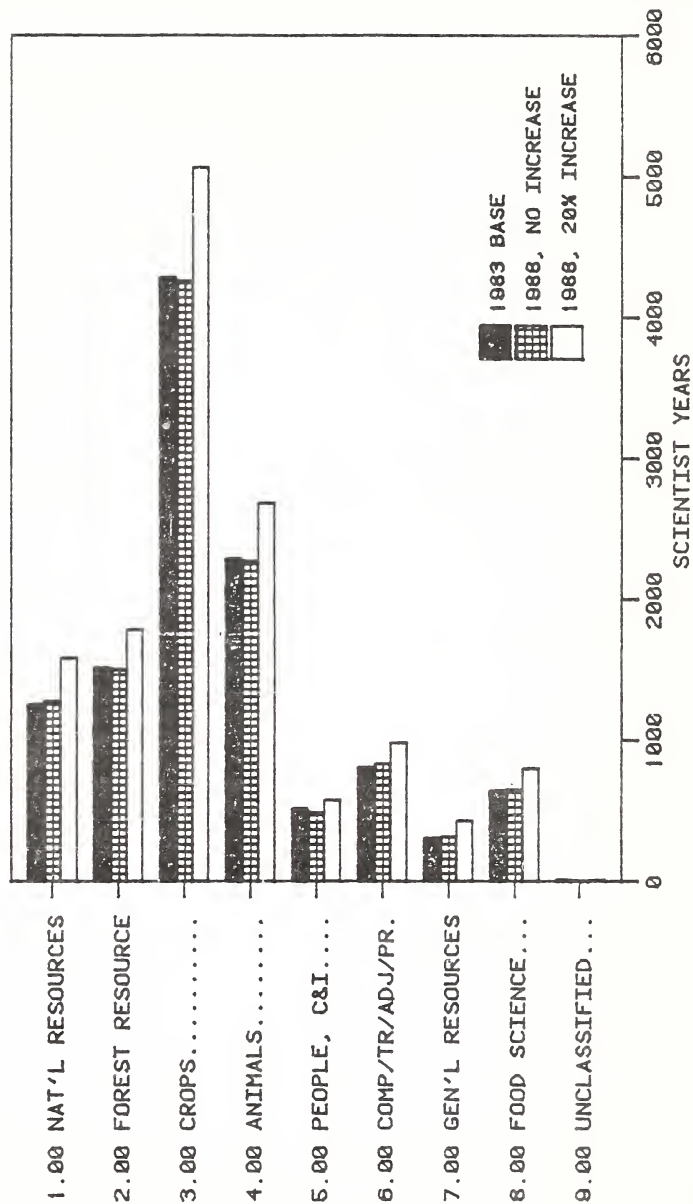
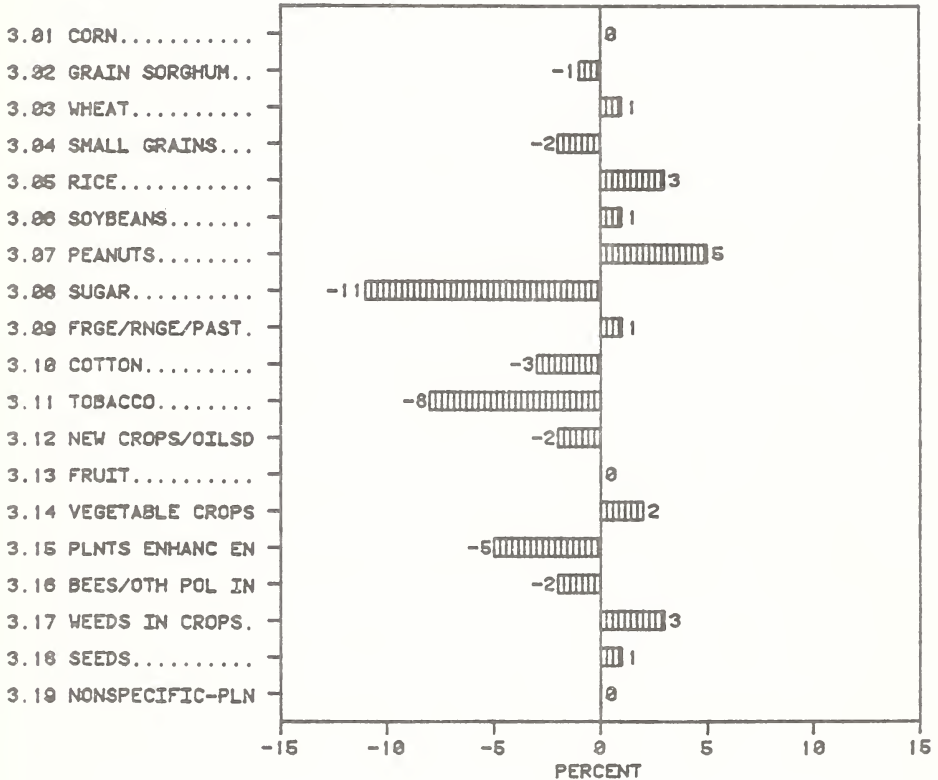


Figure 3

RPG 3.00 CROPS  
PERCENT CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING NO INCREASE, 1983-1988



The Extension Service-USDA performs a key role in support of the USDA mission and goals listed earlier. The Smith-Lever Act of 1914 established the Cooperative Extension Service (CES) system as a unique national partnership of Federal, State, and local governments. The Federal/State/local partnership is the structural and organizational cornerstone of the system.

The mission statement of the national Cooperative Extension System reads: "The mission of Extension is to improve American agriculture and strengthen American families and communities through the dissemination and application of research-generated knowledge and leadership techniques."

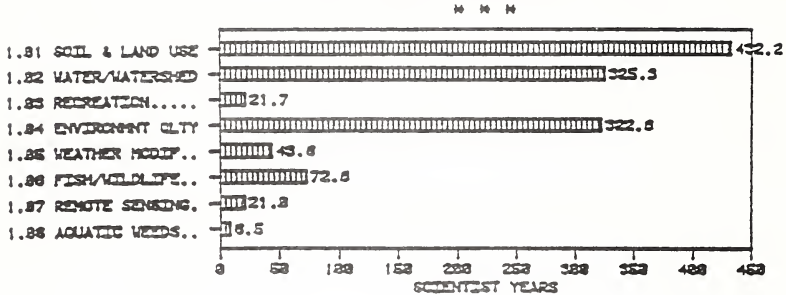
- o Goals. The goals of the Cooperative Extension system provide continuity and focus for the mission. They are based on the expressed needs of people, legislative mandates, and funding requirements. The goals are listed below:
  - To develop efficient agricultural, forest, and rangeland production systems.
  - To enhance the processing, marketing, and distribution of high-quality food and fiber products.
  - To support the conservation and wise use of natural and renewable resources.
  - To strengthen the family and home through the attainment of knowledge, human skills, and technology needed to create a satisfying quality of life within available resources.
  - To assist youth in acquiring knowledge, developing life skills, and forming attitudes that will enable them to become self-directing, productive, and contributing members of society.
  - To strengthen the capacity of State and local governments to deal with public issues and problems.
  - To cooperate with agencies and institutions of Federal, State, and local government and the private sector in developing and conducting educational programs.
  - To cooperate and work with national and international institutions throughout the world in using the Cooperative Extension Services' concept of informal education.
- o High-Priority Program Issues -- Nine high-priority program issues for the Extension Service partners have been identified within the above goals for FY 1984 and beyond. These are an integral part of Extension programs at National, State, and local levels and are:
  - Crop and Animal Production Efficiency.

- Financial Management.
- Food and Fiber Marketing Management.
- Forest and Rangeland Management.
- Management and Conservation of Soil and Water Resources.
- Human Nutrition and Health.
- Leadership Development for Adults and Youth.
- Local Government Operations and Finance.
- Small Business Development and Management.

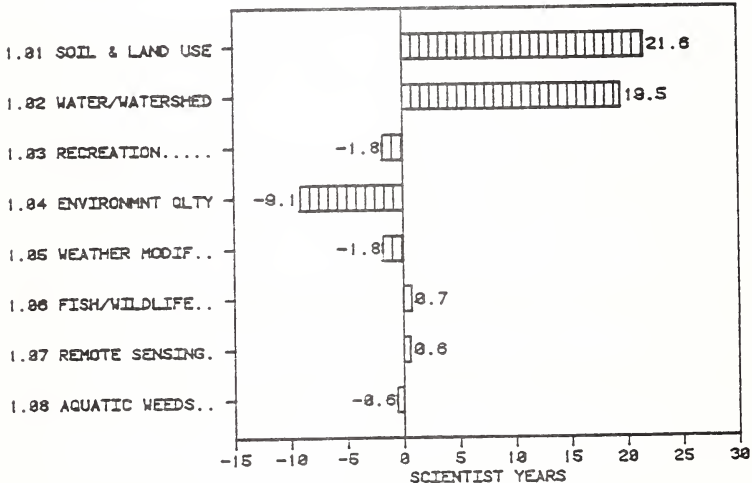
### Implications

Cooperative Extension Service priority program issues tend to relate closely to a number of the recommendations made by advisory groups and the science and education related objectives of the department. However, as with research administrators' projections, a "tight" correlation is not apparent. Not all the entities and organizations with a stake in the functioning of the Federal-State research and education system are represented in this report. For example, State and local governments, which fund the system on an approximately equal basis (in total) with the Federal Government are not represented directly in any of the advisory or executive groups mentioned in this report. This multiplicity of "guiding entities" is not a recent phenomenon, but has existed essentially from the beginning of the food and agricultural research and education "system" approximately 100-120 years ago.

RPG 1.00 NATURAL RESOURCES  
1983 SCIENTIST YEARS, BY RP

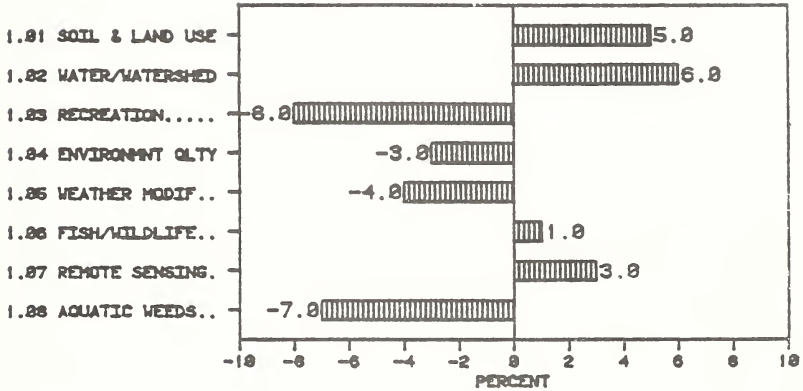


RPG 1.00 NATURAL RESOURCES  
PROJECTED CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING NO INCREASE, 1983-1988

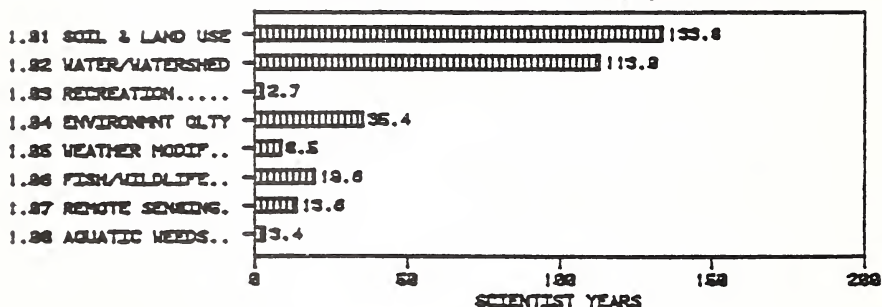




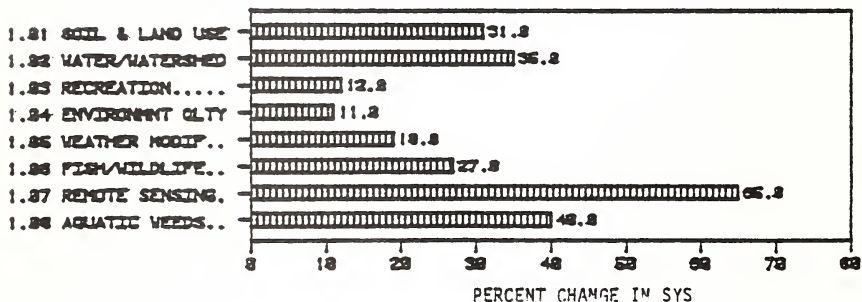
RP6 1.00 NATURAL RESOURCES  
 PERCENT CHANGE IN SCIENTIST YEARS, BY RP  
 ASSUMING NO INCREASE, 1983-1988



RPG 1.00 NATURAL RESOURCES  
PROJECTED CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING A 20% INCREASE, 1983-1988

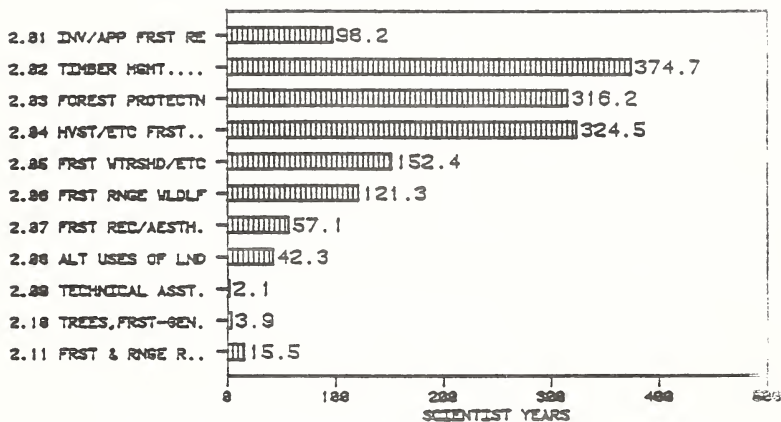


RPG 1.00 NATURAL RESOURCES  
PERCENT CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING A 20% INCREASE, 1983-1988

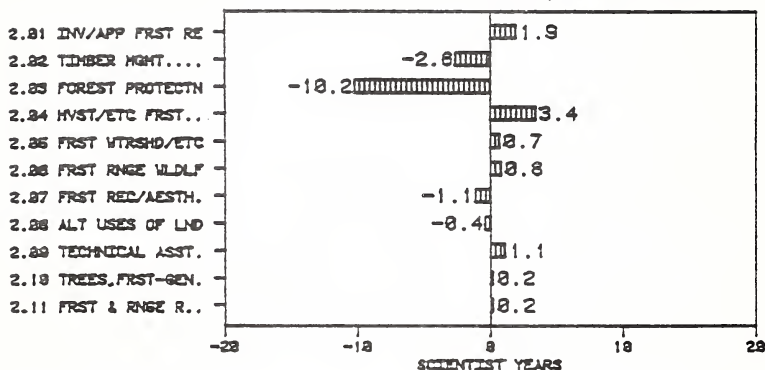


RPG 2.00 FOREST RESOURCES  
1983 SCIENTIST YEARS, BY RP

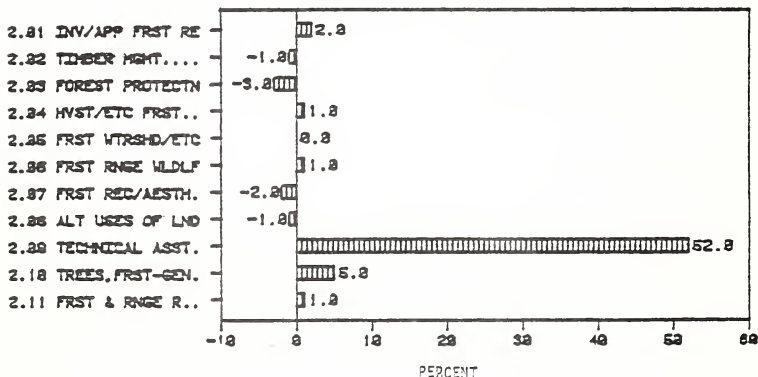
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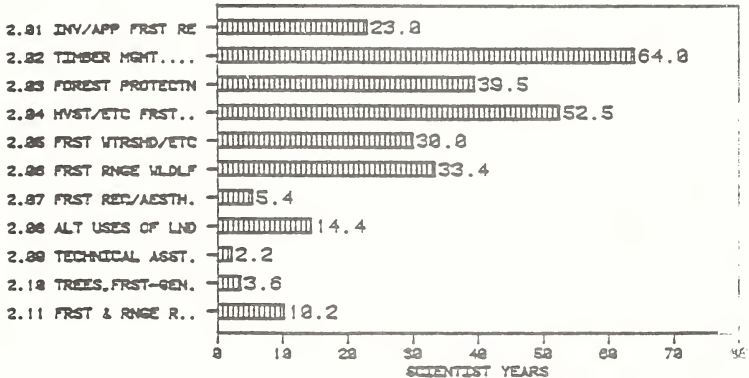
RPG 2.00 FOREST RESOURCES  
PROJECTED CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING NO INCREASE, 1983-1988



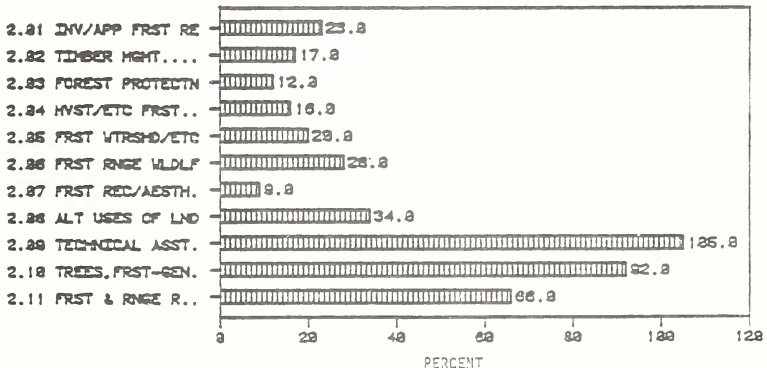
RPG 2.00 FOREST RESOURCES  
PERCENT CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING NO INCREASE, 1983-1988



RPG 2.00 FOREST RESOURCES  
PROJECTED CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING A 20% INCREASE, 1983-1988

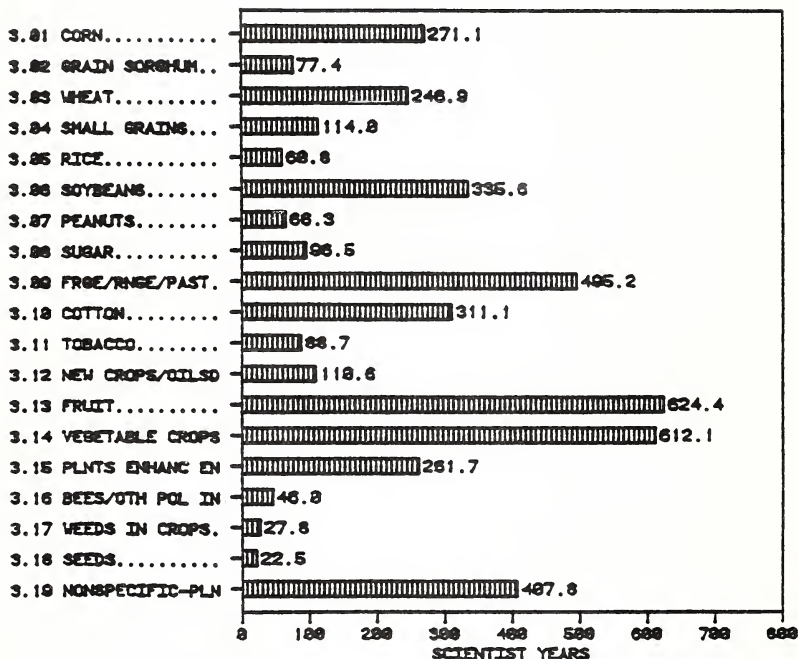


RPG 2.00 FOREST RESOURCES  
PERCENT CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING A 20% INCREASE, 1983-1988

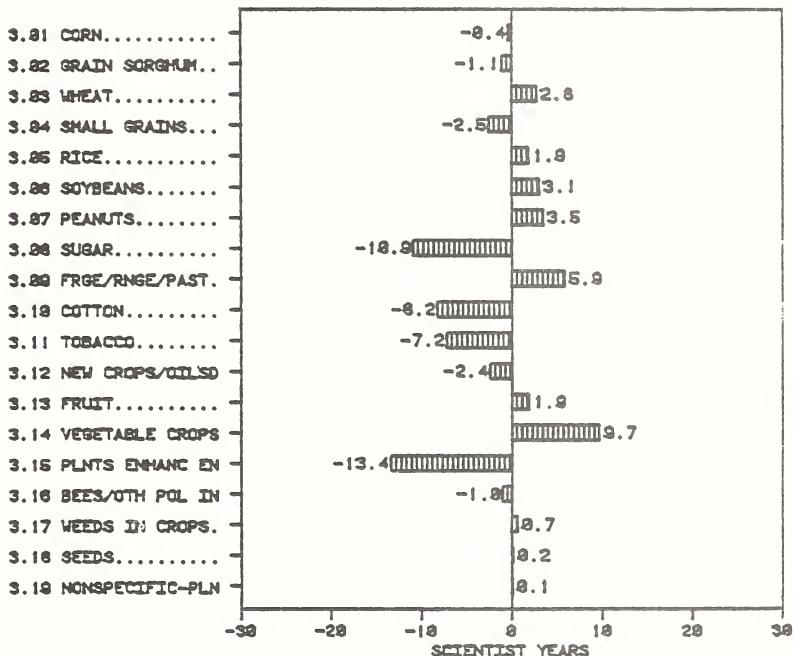


RPG 3.00 CROPS  
1983 SCIENTIST YEARS, BY RP

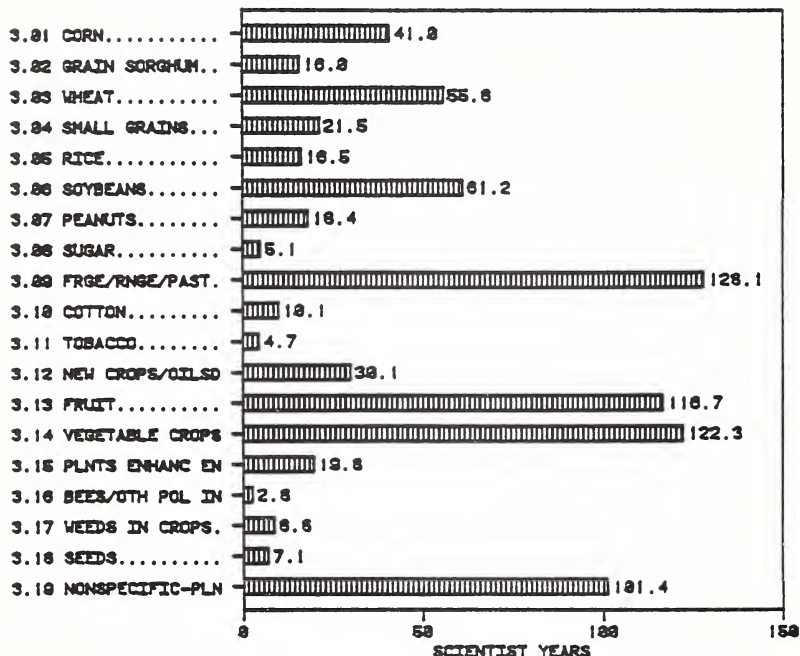
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RPG 3.00 CROPS  
PROJECTED CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING NO INCREASE, 1983-1988

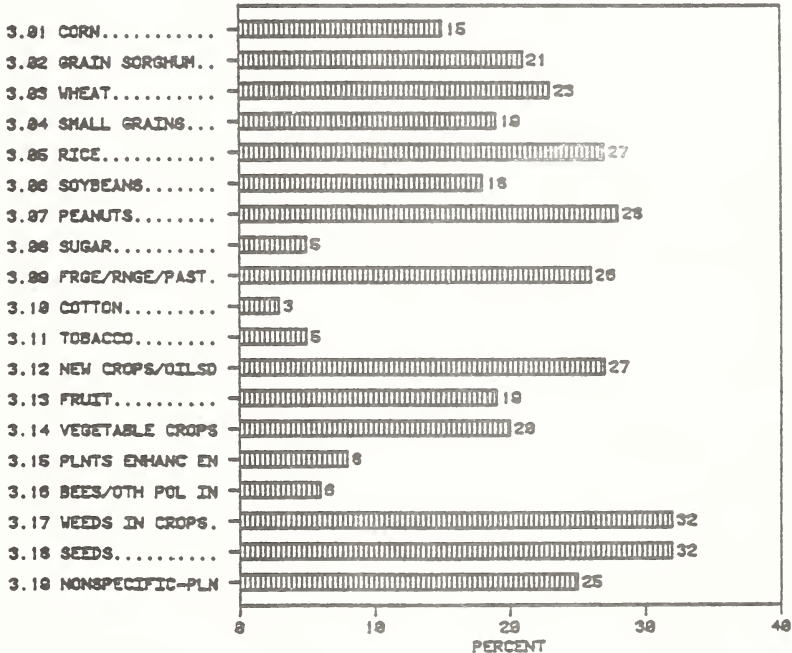


RPG 3.00 CROPS  
 PROJECTED CHANGE IN SCIENTIST YEARS, BY RP  
 ASSUMING A 20 PERCENT INCREASE, 1983-1988

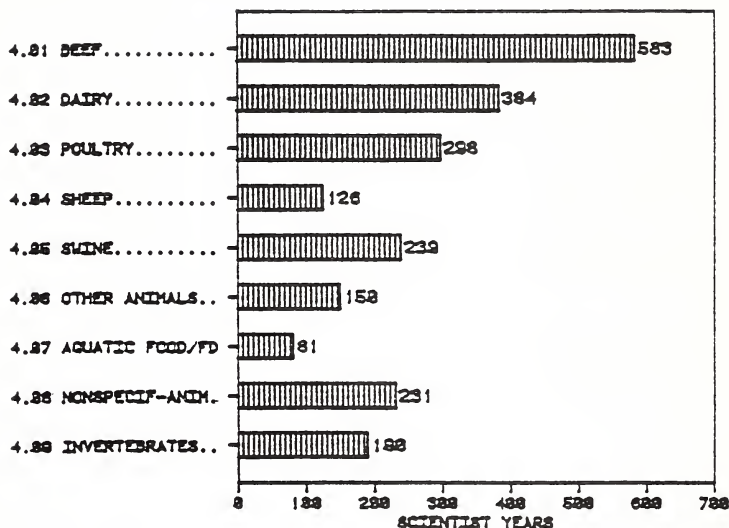




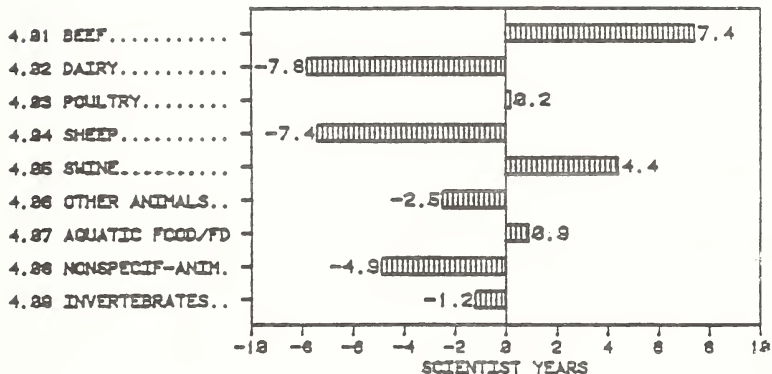
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 PERCENT CHANGE IN SCIENTIST YEARS, BY RP  
 ASSUMING A 20 PERCENT INCREASE, 1983-1988



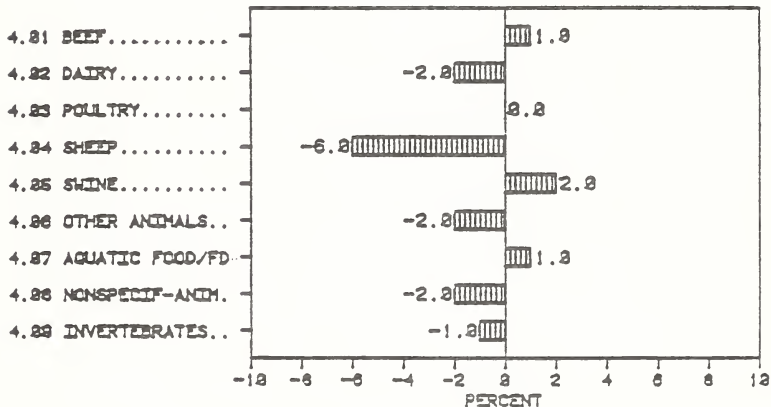
RP6 4.88 ANIMALS  
1983 SCIENTIST YEARS, BY RP  
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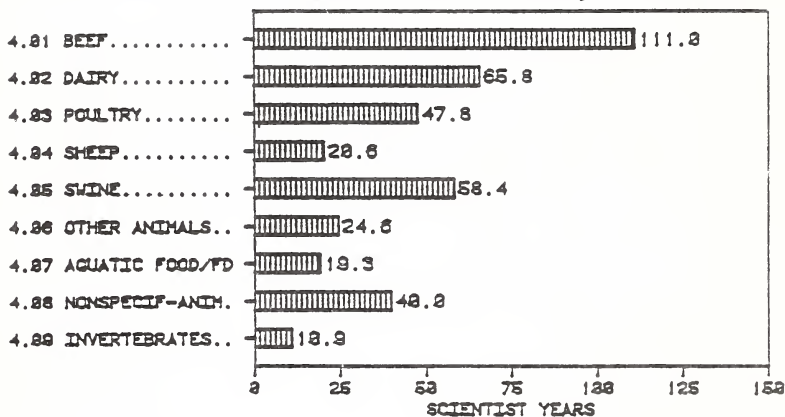
RPG 4.22 ANIMALS  
PROJECTED CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING NO INCREASE, 1963-1988



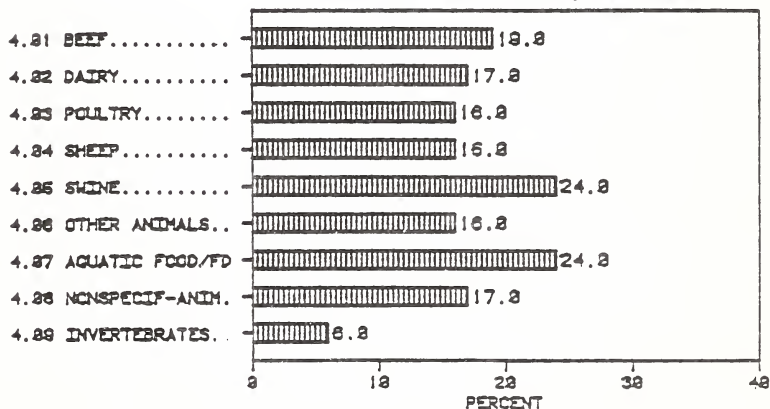
RPG 4.22 ANIMALS  
PERCENT CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING NO INCREASE, 1963-1988



RPG 4.28 ANIMALS  
PROJECTED CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING A 28% INCREASE, 1963-1988

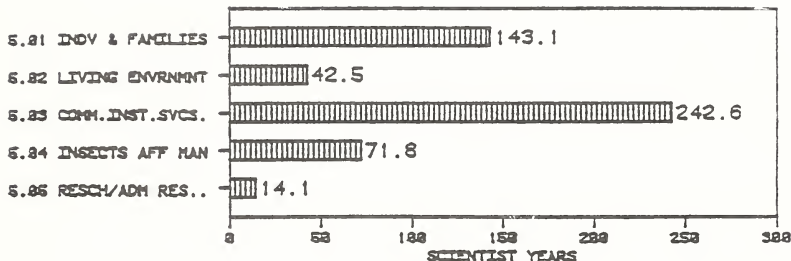


RPG 4.28 ANIMALS  
PERCENT CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING A 28% INCREASE, 1963-1988

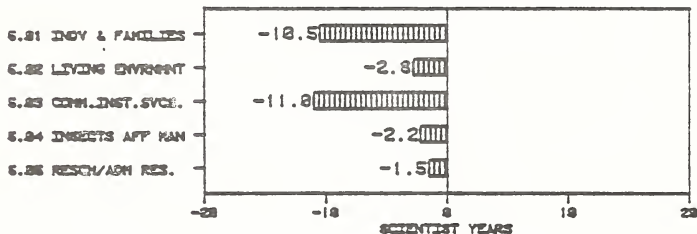


RPG 5.00 PEOPLE, COMMUNITIES AND INSTITUTIONS  
1983 SCIENTIST YEARS, BY RP

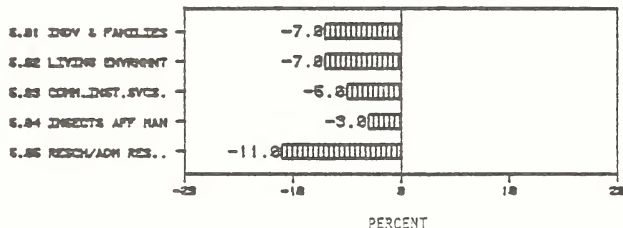
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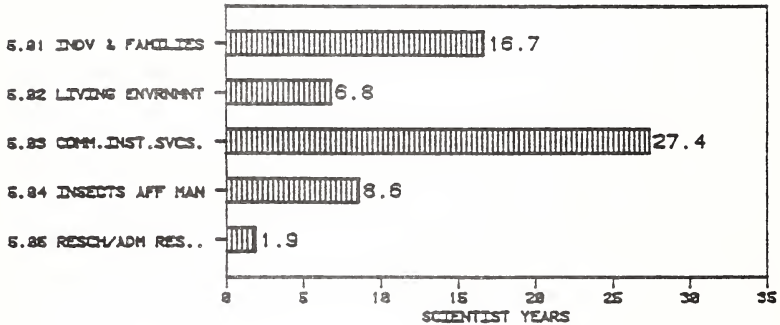
RPG 5.00 PEOPLE, COMMUNITIES AND INSTITUTIONS  
PROJECTED CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING NO INCREASE, 1983-1988



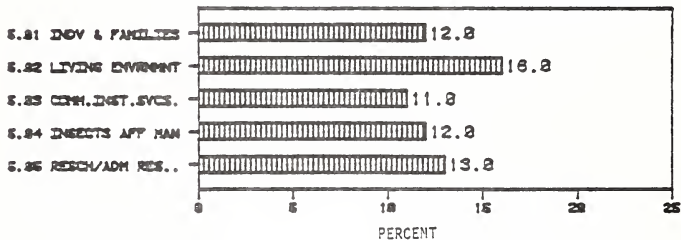
RPG 5.00 PEOPLE, COMMUNITIES AND INSTITUTIONS  
PERCENT CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING NO INCREASE, 1983-1988



RPG 5.22 PEOPLE, COMMUNITIES AND INSTITUTIONS  
PROJECTED CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING A 20% INCREASE, 1983-1988

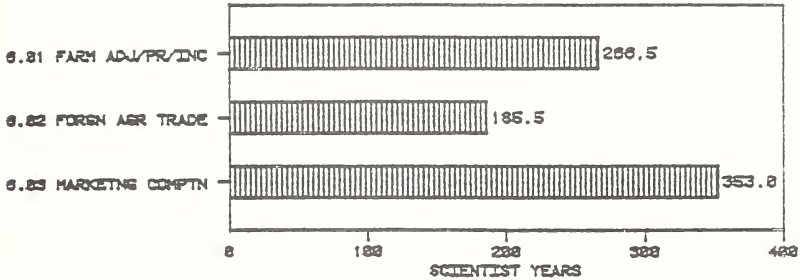


RPG 5.22 PEOPLE, COMMUNITIES AND INSTITUTIONS  
PERCENT CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING A 20% INCREASE, 1983-1988

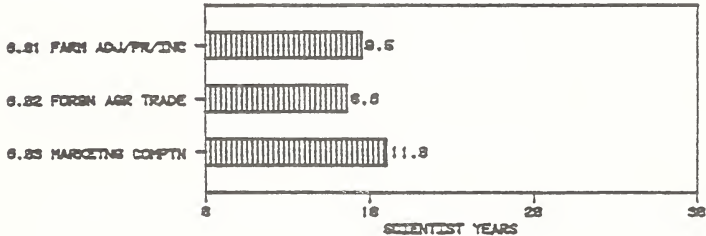


RPG 6.00 COMPETITION/TRADE/ADJ/PRICE/INCOME  
1983 SCIENTIST YEARS, BY RP

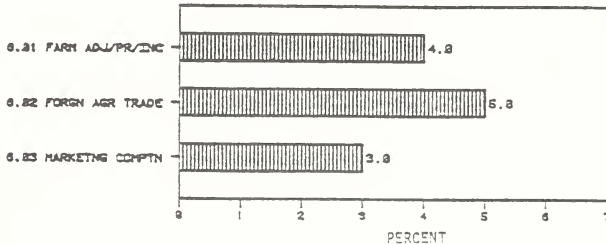
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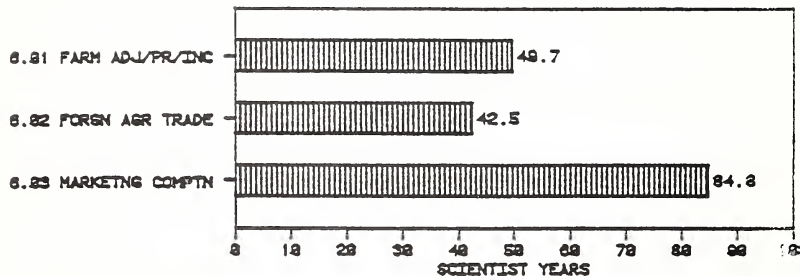
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PROJECTED CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING NO INCREASE, 1983-1988



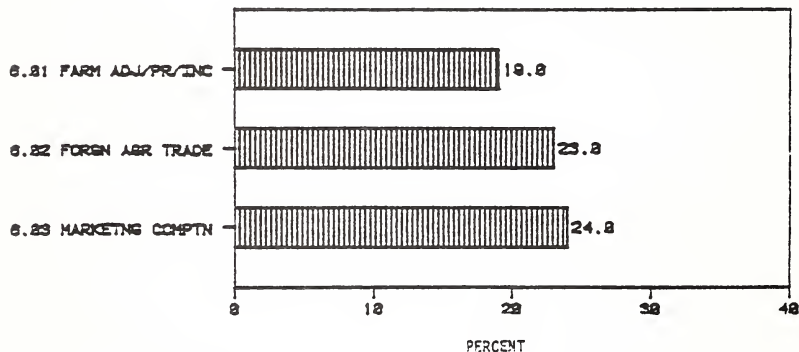
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PERCENT CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING NO INCREASE, 1983-1988



RP6 6.88 COMPETITION/TRADE/ADJ/PRICE/INCOME  
PROJECTED CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING A 20% INCREASE, 1983-1988



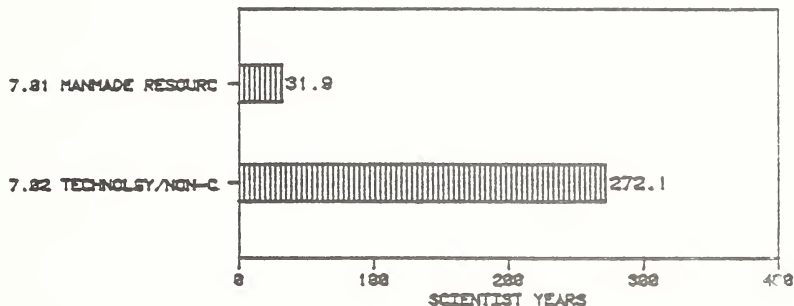
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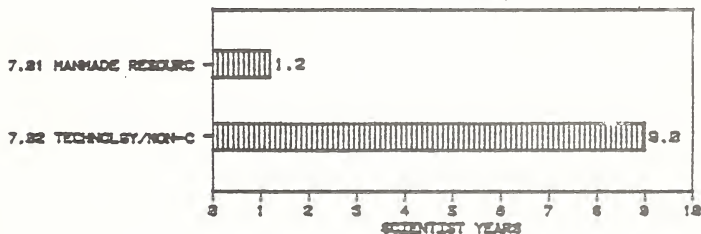


RPG 7.88 GENERAL RESOURCE OR TECHNOLOGY  
1983 SCIENTIST YEARS, BY RP

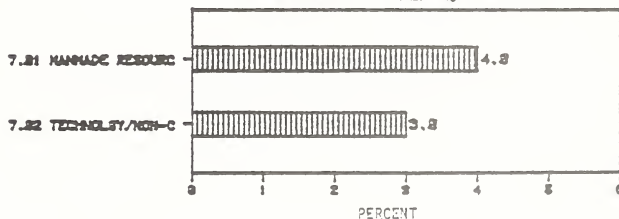
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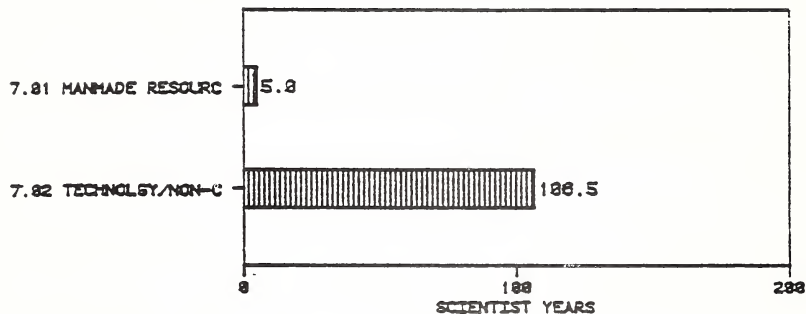
RPG 7.88 GENERAL RESOURCE OR TECHNOLOGY  
PROJECTED CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING NO INCREASE, 1983-1988



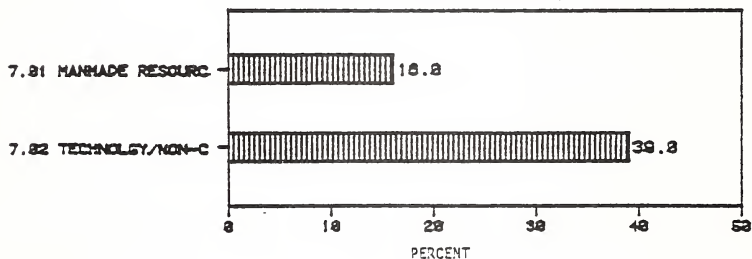
RPG 7.88 GENERAL RESOURCE OR TECHNOLOGY  
PERCENT CHANGE IN SCIENTIST YEARS, BY RP  
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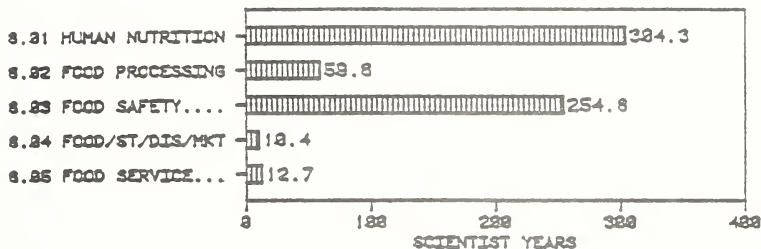
RPG 7.00 GENERAL RESOURCE OR TECHNOLOGY  
PROJECTED CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING A 20% INCREASE, 1983-1988



RPG 7.00 GENERAL RESOURCE OR TECHNOLOGY  
PERCENT CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING A 20% INCREASE, 1983-1988



RPG 8.88 FOOD SCIENCE  
1983 SCIENTIST YEARS, BY RP



RPG 8.88 FOOD SCIENCE  
PROJECTED CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING NO INCREASE, 1983-1988



RPG 8.88 FOOD SCIENCE  
PERCENT CHANGE IN SCIENTIST YEARS, BY RP  
ASSUMING NO INCREASE, 1983-1988

